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The Coal Mine Strike.

As was expected when our previous issue went to press, the country now has a full fledged coal miners' strike on hand, and it has already assumed serious proportions; has resulted in the laying off of many railroad men who had been engaged in transporting coal and in a rise of coal prices here in New York of something like $2 per ton. It is very difficult for anyone to get at the truth of the matter, there are so many stories and they are so directly contradictory. On the one hand there is an effort to make out that the miners are actually in a constant state of starvation and raggedness, while on the other hand, and on the part of the operators, it is attempted to be shown that the miners are as well paid as similar workers anywhere else, and that they earn enough to live in comfort if not in luxury. The yellow journals that always try to make the most possible out of every occurrence of every kind are, of course, making all the fuss they can out of this and it is being charged that the strike is being instigated and even supported by the money of politicians who expect it to have some political effect in the approaching national election. John Markle, a mine owner, or at least operator of the Hazleton district is quoted as saying: "I cannot prove it, but I believe that the strike is supported by money paid to Mitchell by politicians." If there is any truth in this charge it is to be hoped that it will be brought out and it is clear that if such a thing can be proved it will not only react powerfully against the political party that is responsible for it but it will also effectually destroy all public sympathy and support of the strike.

Some figures have been published by the operatives showing the earnings of the miners, but so far none that we have seen that in any way controvert the claim of the men that average yearly earnings are about $250. On this point it should be observed that statements as to what men earned during the month of August do not show what their average yearly earnings are.

Both sides, it seems to us, are in the wrong with respect to arbitration. The operators will not submit to it because, as they say, "it is impracticable and impossible. The interests at stake are too large and complicated and the arbitrators could not understand all the intricacies of the business, and their decision might be ruinous to us." It is needless to point out that the same objections could be raised against any arbitration whatever. The objection has no force. The operators would have their equal voice in the choice of arbitrators, and to claim that men could not be found with understanding enough to comprehend the salient points of the situation and render a just decision is, to put the case mildly, not very complimentary to the general intelligence of the operators' fellow men. It is, of course, a mere quibble and indicates nothing else than that the operators expect to make more money and come out better by refusing to arbitrate and by fighting, right or wrong, than by submitting to the decision of an impartial board of arbitration. On the other hand what seems even less defensible is the position taken by Mitchell and the organization he represents in regard to the miners employed by G. B. Markle & Co. This firm have had an agreement with their men since 1885, according to which all grievances of the men should first be presented to the employing firm and then if there were a failure to settle the matter satisfactorily to both sides arbitration was to be resorted to and both sides agreed to abide by the decision of the arbitrators. But when John Markle, who is the head of this firm, asked that the mines of his company be exempted from the strike on the ground that he conceded and for years had been conceding the claims made by the men for arbitration, he was answered by Mitchell to the effect that the strike in the Markle mines would not be called off, and that the only arbitration the men would submit to was for the whole anthracite mining district. To our mind this is not only a serious tactical mistake and distinctly weakens the position of the miners, but it is acting in bad faith. Here was a chance to put into play the principles the miners say they are striving for. Had they accepted the proposition of Mr. Markle they could have pointed to one mine in which the principle of arbitration was recognized and operative and could have shown that the results of it were good. As it is the operators can point to a mine, the owners of which do and for a long time have, conceded the right of arbitration but which, nevertheless, the Mine Workers' Union tries to close the same as the others, all the while crying out for the recognition of the principle of arbitration.

In the meantime, saying nothing of the inconvenience and hardship to domestic consumers of coal, the industries of the country, which depend upon it and which do not enjoy the benefits of a monopoly of their raw material nor of the means of shipping it, but must meet open and free competition from all quarters, are likely to be seriously interfered with and perhaps, in some cases permanently impaired by a strike, that it is impossible to believe could not have been avoided had there been, on both sides, a disposition to be reasonable and fair.

Friday the 21st, Mr. Mitchell made a statement in which he declared that nine railroads and their presidents, whom he named, were the real parties against whom the miners were contending. These roads, Mr. Mitchell says, "besides producing approximately 72 per cent. of the hard coal, are the sole carriers to tide water of all coal mined in the anthracite field of Pennsylvania, and for this service of car-

riage a charge of from 40 to 68 per cent. per ton, according to the size of the coal, is made. Incredible as it may appear, they charge three times as much to carry a ton of anthracite coal 100 miles, as is charged to carry a ton of bituminous coal the same distance. So exorbitant are the rates that the legitimate profits that should be credited to the mining departments of these railroads are absorbed by freight rates, and as a consequence their coal properties are made to show a very small profit on their capitalization." He then claims that the individual operators are themselves also victims of the railroads and are at their mercy; being unable to make any arrangements or agreement with their men that will be lasting except so long as these nine railroad companies choose to have them so.

We are hearing a good deal about the miners—Poles, Hungarians, etc.—being a "bad lot," and no doubt they are. They are people who have had little opportunity for developing the virtues of politeness, etc., in their own countries and most of them have come here in the hope of escaping from oppression and of bettering their condition. Some who ought to know better say that "they ought to be shot," and that they are "entitled to no consideration whatever." But suppose they were all shot, then in order to have our coal mined the companies would simply import a lot more of the same kind of people. That is what they did in times past to break up strikes of English-speaking miners. The mine owners themselves are responsible for these people being here, as the history of American coal mining indubitably proves, and unless some different method of dealing with them can be found there is no other prospect than that these strike difficulties, disorders, murders, interruptions of business and heavy expenses to the people incurred from the necessity of putting down disorder will go on and be repeated to the end of time.

That these roads do actually make exorbitant charges for carrying anthracite coal to market does not rest upon the unsupported assertion of Mr. Mitchell. In the famous case of Coxe Bros. (independent mine owners and producers) against the Lehigh Valley R. R., a case tried before the Interstate Commerce Commission in 1893, this was proven and the Commission ordered the rate reduced to a specified sum. This decision has not been enforced, however, because there seems to be no authority to enforce it, and the roads snap their fingers at it. This exorbitant charge is, of course, made for no other purpose than to prevent independent mine owners from competing with the mines owned by the railroad companies and the coal consuming public has to foot the bills.

It will be recalled that when, something less than a year ago, the machinists and their employers in many shops disagreed and the situation for a time looked ugly, reason prevailed and a settlement nearly enough satisfactory to both sides for all practical purposes was arrived at as soon as the representatives of the employers and of the men got together and discussed the situation. There is far more reason why this should be done in the case of coal miners, because so many more outside people are in one way or another interested in continuous supplies of coal than they can be in the operation or non-operation of a number of machine shops. For the failure to come together for conference, we think it is evident that the mine operators and not the men are chiefly, if not solely responsible.

Partly on account of its interest as bearing upon this question, we publish in another column an article on arbitration in New Zealand. This, however, is compulsory arbitration, and it seems to us that much may properly be said against the principle of compulsion in arbitration of labor difficulties, especially where the trouble concerns only one establishment and the men employed in it and does not vitally effect the community at large.

The article published elsewhere in this issue on the machinery trade in Spain, is interesting and should not be missed by those who are interested in the development of our foreign trade in machinery. The instance of a foreign firm of machinery dealers having the *exclusive* agency for an American machine tool in Spain, and then refusing to accept bona fide orders from that country, saying they had no faith in Spanish trade and preferred to be without orders from there is especially interesting, as showing an extreme case of how some exclusive agents sometimes look after trade within territory assigned to them and suggests the importance of manufacturers taking some means of knowing whether their exclusive agents abroad are really doing anything to push trade or not. The points about Spanish patents are also interesting and there might be much that could be said in favor of a law that would protect for a limited time the person who first manufactured for the market an article of utility, whether invented by him or by some one in another country. At least it would be in some respects preferable to protecting those who own patents on things they do not manufacture and do not intend to manufacture.

Mr. A. S. Capehart, Director of Liberal Arts and Chemical Industries, at the Paris Exposition, informs us that a Grand Prize was bestowed upon the exhibit of United States journals, of which exhibit the "American Machinist" forms a part, and that we are, therefore, entitled to use this award of Grand Prize. While we may be entitled to use this award, it is probable that we shall not do so, because we believe that the "American Machinist" will be judged by its readers and others upon other considerations than the award of a prize.

Personal.

The American Bridge Company announces that Mr. August Ziesing has been appointed as the general Western representative of the company, with headquarters at Chicago, Ill.

John J. Inniss, the works manager of the British Thomson-Houston Company, which is building a new works at Rugby, England, sailed for home on the 22d, after having spent several months in America inspecting shops and shop methods. With him went S. O. Bartlett, a well-known American tool maker, who goes to take a responsible position with the same company.

Jacob E. Gombar, for five years with the Newton Machine Tool Works, has become partner and mechanical superintendent of Frederick H. Gliem & Co., successors to Lucas & Gliem, manufacturers of machine tools, Philadelphia. In addition to the experience gained with the Newton Company, Mr. Gombar was for several years superintendent of the Columbia Fire Arms Company, afterwards had charge of the elevator screw department of the Sprague Elevator Company and was more recently with the Midvale Steel Company for three years.

Obituary.

L. L. Bliss died at Corry, Pa., September 9, seventy-two years old. He was superintendent of the Gibbs & Sterratt Mowing Machine Company thirty years, and was a large stockholder in the Ajax Iron Works, of which his son is superintendent.

Isaac Richardson, an old machinist, died at Manayunk, Pa., Sept. 21, about eighty years old. He began to learn the machinist trade when 17 years old and worked for I. P. Morris & Co., Kensington, Pa., 44 years, having been for many years in charge of one of the company's mills. He retired from active life 15 years ago.

The fact that British trains and British ships no longer hold the records for fast runs is, "Transport" states, due to the fact that Englishmen prefer safety and comfort to speed. This contention may be comforting to British pride, but no evidence has yet been advanced showing that the Deutschland, for instance, is less comfortable or less safe than the "Oceanic," or the "Empire State Express" than the "Flying Scotchman." As a matter of fact, our railway and steamship managers hold, rightly or wrongly, that these high speeds do not pay, and on this ground their lack of enterprise is quite intelligible; but not unnaturally they wish the public to believe that they are actuated by different motives,

and hence we have these baseless insinuations as to the dangers and discomforts of the foreign "flyers."—"Engineering."

Machinery Industry in Massachusetts.

The Commonwealth of Massachusetts interests itself to an admirable degree in the collection and publication of statistics of industrial affairs within its territory. There has lately been given out the second part of the 14th annual report upon statistics of manufactures for 1898, 1899, compiled under Horace G. Wadlin, chief of the Bureau of Statistics of Labor. It comprises an account of the manufacturing establishments and their management; of investment, materials used, and product; of labor and its compensation; of working time and proportion of business done; with a general summary of industrial conditions. "Machines and Machinery" constitutes one of eighty-eight classes of manufacture running through the tables given. We abstract the more important data for the division referred to.

Under "Machines and Machinery," there are considered 358 "establishments," that is mills, shops or factories. This number is not understood to include all in the State. They were controlled in 1899 by 224 private firms, having 322 male and 9 female partners, besides 6 estates; by 8 "combinations" and 126 corporations with 3,527 stockholders. The capital invested was $32,721,191 in 1898, and $35,178,135 in 1899, showing an increase of 7.51 per cent. The stock used was $9,467,633 in 1898, and $13,441,050 in 1899, an increase of 41.97 per cent. The value of goods made and work done was $27,374,142 in 1898, and $36,619,659 in 1899, increasing 33.77 per cent.

The average number of persons (wage earners) employed in 1898 was 17,406, of whom 17,138 were males and 268 females. In 1899 the number was 21,593, comprising 21,303 males and 290 females. The increase in the total number was, therefore, 4,187, or 24.05 per cent. The aggregate number of persons employed at periods of employment of smallest number was 14,341 in 1898, and 17,362 in 1899, an increase of 3,021 or 21.07 per cent. The aggregate number at periods of employment of greatest number was 20,287 in 1898, and 26,103 in 1899, an increase of 28.67 per cent. The excess of greatest over smallest number of persons employed was 5,946 in 1898, and 8,741 in 1899, an increase of 2,795 or 47.01 per cent. Considered upon a basis of 100 per cent. in December the percentage of persons employed rose with slight fluctuations through each year from 91.55 per cent. in January, 1898, and from 80.65 in January, 1899. There was no apparent falling off in this respect in the summer months. Both of the years were, therefore, characterized by a steady increase in number of persons at work.

Wages paid amounted to $9,582,762 in 1898 and $11,968,298 in 1899, an increase of 24.89 per cent. The average yearly earnings of wage workers were $550.54 in 1898 and $554.27 in 1899, an increase of but $3.73, or 0.68 per cent. These average earnings are calculated by dividing the total amount paid in wages during each year by the average number of persons employed during the same year. The increase shown in 1899 is surprisingly small, and if the increased cost of living be taken into consideration, the conclusion seems to be inevitable that the workman who was fortunate enough to have employment both years was worse off during that of greater general prosperity.

The average number of days of operation of the establishments, based upon the average number of persons employed, was 287.84 in 1898 and 299.12 in 1899, an increase of 11.28 days, or 3.92 per cent. The average proportion of business done, rating greatest capacity or maximum production at 100, was 57.51 in 1898 and 64.98 in 1899.

The General Society of Mechanics and Tradesmen, of 20 West Forty-fourth street, New York City, has added a new department to its library, to be composed of catalogs of all kinds, connected with building, contracting, machinery supplies, etc. The catalogs will be kept on file, properly indexed, and to be accessible at all times to anybody desiring to consult them, and will constitute a part of the library, which now consists of over 100,000 volumes and is free to all applicants. The society will be glad to receive catalogs for its file.

The Bethlehem Steel Company received on September 1 a telegraphic order for a port propeller-shaft, to replace one which had been broken in the Plant Line Steam Ship "Le Grande Duchesse." This shaft was specified to be made of fluid compressed, open-hearth steel forged under hydraulic pressure, annealed and rough-turned. The shaft measured 32 feet in length over all by 13¼ inches diameter, the shipping weight being 15,458 pounds. It was shipped on September 6, five days in advance of requirements, which were that it be shipped September 11.

Commercial Review.

NEW YORK, Saturday, Sept. 22.

BUSINESS ON A DEAD CENTER.

The impression derived from answers to inquiries made at this time, among the trade, more especially in the machinists' supply line, is that while demand may be slightly better this month than last, there is not the increase from summer to fall that might be expected ordinarily. Business manifests little tendency to undergo any change whatever. It is on a dead center, yet whether the next stroke will be an upward one or a downward one, nobody knows. A cheerful view and one that may, with all propriety be taken, is that industry is merely waiting upon the election and also for a little better information as to future values. But the present indisposition to novelty in business character is not to be deplored when, as in no inconsiderable proportion of the cases that have come to notice, it does not mean a continued dullness, but a prolonged experience of more than average activity.

Montgomery & Co. booked more mail orders on a certain day this month than on any other day of their experience. These orders, however, were small ones, which indicate a hand to mouth policy on buyers' part. Many of them were called out, it would seem, by the issue of a new catalog. The August business of the firm this year, however, beat that of August, 1899; September returns not yet being in shape to pass judgment.

The Arcade File Works are enjoying an unprecedentedly heavy trade. The latest information obtainable as to the leading manufacturers of measuring instruments, etc., indicates that they are very busy.

Prices of drills, files, etc. are firm and steady. A reduction of 5 per cent. is reported on a line of small engine lathes.

A selling arrangement of considerable importance has been made among four makers of steel balls, the Grant Ball Company, Cleveland; the Cleveland Ball & Screw Company, the Steel Ball Company, Chicago, and the Excelsior Machine Company, Cleveland. Their product is now handled in common by a company known as the Central Distributing Company, 302 Mooney-Brisbane Building, Buffalo, N. Y. A material advance in price has been effected, averaging some 20 or 25 per cent., though it is much more than that on certain sizes. The American Bicycle Company is not a direct participant in the arrangement, but is said to be acting in harmony with the selling combination in the advance of prices. The fate of price agreements has, in some cases, been a disastrous one this year, for instance, in that of the cold-rolled shafting combination, which went to pieces a few weeks ago. The wood pulley agreement has developed alarming leaks in several places during the season, but prompt and vigorous attention has kept the ship afloat. The soundness of the valve combination embracing a number of selling concerns has seriously been called in question.

A meeting of the stockholders of the Pratt & Whitney Co., held September 20, to take action concerning the sale of stock to the Niles-Bement-Pond Company resulted only in another adjournment. It is claimed that out of the 27,500 shares of Pratt & Whitney stock all but 2,500 shares have agreed to the project. These shares are scattered, some of the holders being off on their vacations and a belief is ex-

pressed that shortly they will enter into the plan.

The boom in shipbuilding has not only led to the establishment of important new works on the Atlantic seaboard, as factors of competition, but it appears that the supremacy of the Union Iron Works upon the Pacific Coast is to be challenged. At any rate a new shipbuilding enterprise, of great importance, is to be carried out at San Francisco, by the Risdon Iron Works, who already have their representatives in Washington preparing estimates for the new battleships and will be prepared to contract for at least two of the new vessels.

The Risdon Iron Works have purchased the property of the old Pacific Rolling Mill Company, in the Potrero, San Francisco, consisting of some 32 acres of ground, immediately adjoining the Union Iron Works, and with a deep water frontage of over 1,700 feet. Steps are being taken to build a dry dock 500 feet long by 100 feet wide. New wharves are in course of construction. Several new steel frame buildings are contemplated and orders have recently been placed covering structural materials for the following buildings: Machine shop, 308x100 feet, total lift over main floor, 45 feet; boiler shop, 140x180 feet, lift over main floor, 40 feet; machine and ship blacksmith shop, 300x60 feet; foundry, 177x160 feet; ship joiner shop, 140x81 feet. The machine shop will be equipped with four electric traveling cranes of 50 tons, 20 tons, 15 tons and 10 tons capacity. Each crane will be equipped with 5-ton auxiliary hoists. The boiler shop crane equipment will consist of one 60-ton, one 20-ton and one 10-ton electric traveling crane—each equipped with 5-ton auxiliary hoists. The foundry crane equipment will consist of one 30-ton and one 20-ton electric traveling crane with 5-ton auxiliary hoists. The ship blacksmith shop will be equipped with eight jib cranes with 5 and 10 tons capacities. The machinery equipment throughout will comprise the most modern tools. The entire plant, except the steam hammers in the blacksmith shop, will be operated by electricity, and contracts have recently been placed with the Independent Electric Light & Power Co., of San Francisco, to furnish power. Direct current will be used for the cranes and an alternating current for the machinery equipment. Separate motors will be installed in each department. The cost of electric power for operation of the plant for the first year will amount to over $30,000.

Additions of some magnitude are to be made at the crane plant on Mifflin and Meadow streets, Philadelphia, of the Philadelphia Engineering Works, controlled by the Niles-Bement-Pond Company. Two fire proof structures will be erected, one an extension 40x66 feet and the other a new building 200x100 feet, and three boilers will be set. This work will be done by the Fort Pitt Bridge Works, Pittsburgh, Pa.

In the change affecting the firm of Lucas & Gliem, manufacturers of machine tools, etc., Philadelphia, Mr. Lucas retires and the business continues under the name of Frederick H. Gliem & Co. The active partners in the firm are F. H. Gliem, formerly connected with the General Electric Company, who will give his attention to the business end and electrical construction department, and Jacob E. Gombar, whose long experience in various shops fits him for the superintendence of the mechanical end. They report a steady gain on the orders delayed by the dissolution of the old partnership and a large number of new ones; and express themselves greatly encouraged by the outlook.

A change of some interest has been made by the Brown & Sharpe Manufacturing Company, to take effect October 1, after which date Manning, Maxwell & Moore will no longer handle the Brown & Sharpe machinery in New York. Quite naturally the Brown & Sharpe company does not care to state in full and in detail the reasons which have led them to discontinue the arrangement they had with M., M. & M., but simply say that they have come to the conclusion that they can handle their business independently more in accordance with their own ideas, and have taken action in accordance with that conclusion.

CHICAGO MACHINERY MARKET.

Several machinery men who have been traveling in Ohio, speak in glowing terms of the possibilities that are there opening up for power equipment in the many inter-urban street railway projects. It is related that scarcely a steam road in the western and northern part of that State is escaping the parallel line of the electric road, if all the projects under way are consummated. The electric roads already in operation are said to be financially successful, thus making for the seller of the necessary bonds for construction a comparatively easy task. The region of activity in this development reaches over into Indiana, and there are active spots in Illinois, Michigan and Wisconsin. Inquiries for power from the above sources are frequent, and mining enterprises also are calling strenuously for power. Municipal corporations also are inquiring for power for various purposes.

For the shop the relative demand for power just now is slow. Some business is being closed week by week, but the generality of the trade that engine and boiler-makers are now receiving, comes from other departments of activity. As a rule, boiler-makers are crowded with work, and instances are reported here where desirable business has been refused because of insufficient producing capacity. Engine makers are likewise well filled with orders. There have been almost innumerable "jobs" which have "died" this year. One engine representative here has on his desk a large package of carefully printed cards, each of which represents one of these "deaths." Each inquiry, when first presented to the engine builders had every promise of survival. The local strikes and other causes contributed to the excessive mortality of these projects and the trade is not without hope of many resuscitations, when another season dawns. For small boilers and engines, three months are now the common period of delivery, which forces shipment into the winter, thus making trade naturally quiet just now.

The E. P. Allis Company has sold two 25,000,000 gallon pumping engines to the city of Detroit on twenty-one months delivery. Three 2,500 horse-power direct connected vertical engines were included in their late street railway contract for Sydney, New South Wales. They have taken orders for one 2,800 horse-power engine for traction purposes at New Orleans and a 6,000 horse-power compound engine with one vertical and one horizontal cylinder for a steel mill in the Pittsburgh district.

Wickes Brothers have sold three 250 horse-power vertical boilers and one 750 horse-power cross compound Corliss engine to the Monolith Portland Cement Company, Battle Creek, Mich. They are sold three or four months ahead and are running overtime.

A. L. Ide & Co., have sold one 300 and one 150 horse-power engine to the Otis Elevator Company, Chicago.

Quotations.

NEW YORK, Monday, Sept. 24, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$16 00 @ $16 50
No. 2 X foundry	15 25 @ 16 00
No. 2 plain	14 75 @ 15 50

Alabama Irons:

No. 1 foundry, or soft	16 25 @ 16 50
No. 2 foundry, or soft	15 25 @ 15 50
No. 3 foundry	14 75 @ 15 00
Foundry forge	13 75 @ 14 25

Bar Iron—Base sizes—For refined brands on dock, 1.40c., and 1.65 @ 1.75c. for same from store.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Base sizes — From store, 1.65 @ 1.75c.

Cold Rolled Steel Shafting—Base sizes —From store, 2c. upward.

Copper—Lake Superior ingot, in carloads, 16⅞c.; electrolytic, 16¾c.; casting, 16⅝c.

Pig Tin—28¼ @ 28½c. for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½@.05c. extra for carloads, New York.

Spelter—Prime Western, 4.10 @ 4.15c. New York delivery.

Antimony—Cookson's, 10½ @ 10¾c.; Hallett's, 9¼c.; United States, 9.20 @ 9⅜c. It is understood that Japanese is obtainable as low as 9c.

Lard Oil—Prime city in barrel lots, 59c.

A Reading Room and a Drop Box for Suggestions.

Sometime ago we published an account of the department of cuisine instituted by the Cleveland Twist Drill Co. in its factory, and we are glad to know that the results of this and other measures of the company have been so encouraging as to lead to further progress, and we show herewith two views within their works, the first of which is of a reading room provided in an, as yet, otherwise unoccupied portion of the factory where will be seen desks containing technical and other papers with a book-case containing books likely to be of interest to the men, while at the left is an upright piano, it being found that during portions of the noon hour, otherwise unoccupied, the men enjoy a little music and are thus enabled to have it. The second view is that of a box for suggestions and complaints, which, in this case, are restricted to matters connected with the reading room, and by which it will be seen that the company do not hesitate, but in fact encourage expressions of opinion from the men with regard to what may be done with this department, and the letter posted above the box gives assurance that every suggestion or complaint signed by the writer will receive consideration. There is much evidence that ideas of this kind which were first promptly brought into notice by the National Cash Register Company, of Dayton, O., are gaining headway among our American factories generally and so far as tried, we believe the results have always been favorable and encouraging.

A DROP-BOX FOR SUGGESTIONS AND COMPLAINTS.

Prizes to Employees.

The practice of awarding prizes to employees for suggestions pertaining to the work or to the management of business is steadily gaining ground, and we are glad to say is everywhere leading to good results, far beyond the mere receipt by the men of the money awarded or the direct benefits resulting from the improvements thus introduced. It generates an entirely different spirit than the plan too often followed of simply snubbing an employee who makes a suggestion, for fear "he will get a swelled head and want to run the business," and then perhaps afterwards stealing his idea and appropriating it without giving him any credit whatever for it, to say nothing of a monetary reward. One of the latest firms to adopt the prize plan is J. H. Williams & Co., of Brooklyn, who on the 15th of last July posted in their works the following:

NOTICE.

"To encourage our employees to use their heads as well as their hands, we offer to divide $100 among the four of our men who shall, between this date and January 1 next, make the best suggestions for improvements, as explained below.

"Prizes will be as follows: First, $50; second, $25; third, $15; fourth, $10.

"The first prize will be given the employee making the most valuable suggestion which may take any form, either as to management, improvement in machinery and tools, cheapening methods of production, handling material, or anything pertaining to the general advancement of the business. The second, third and fourth prizes will be given for the next best suggestions, respectively.

"Neither prizes nor suggestions will be confined to any department.

"No foreman, assistant foreman nor office employee may enter this competition. It is open to all others.

"A box will be provided, into which the suggestions may at any time be placed. These we prefer in writing, with date and signature, and it would be wise to make two copies—one for the box, the other to be retained by the employee. Suggestions, however, may be made verbally to any member of the committee designated below. All suggestions will be considered promptly after receiving them.

"The Committee of Award will consist of the foreman of the die department, the foreman of the forge department, the foreman of the finishing department, the chief engineer and the officers of the company.

"The prizes will be distributed between January 1 and 15, 1901."

We are informed that one set of prizes has been awarded, and that the plan has so far worked well.

The Cincinnati Milling Machine Company has also for some time past been carrying on this plan of inviting and receiving suggestions from the men in the shop, and speak encouragingly of the results. In adopting the plan, which includes also a profit-sharing scheme based on reduction of shop expenses, some of the problems that are to be solved in the conduct of a manufacturing business were discussed with the men in a way that might be useful in many other shops. It was declared that the company was not looking for, or desiring, low wages for the men, but high wages. What they must look after, however, is low shop costs in proportion to the amount and quality of the work turned out. It was pointed out to them that the products of the shop were now going all over the machinery-using portions of the globe, and were in many cases sold in competition with machines

READING-ROOM AND LIBRARY FOR EMPLOYEES. CLEVELAND TWIST DRILL COMPANY.

designed to do the same work, and built by men working for considerably less wages than those paid in the shops of the Cincinnati Milling Machine Company, and what they had to look out for was to keep the cost of manufacture down to such a point as would enable this competition to be met. The company believed that if they were to set out to get into their employ the pick of the best men that were to be found in the city, they could afford to pay 20 per cent. more wages than they were then paying, but they preferred to retain their present force. It was plain, however, that in order to continue the business, it must be the constant effort of all interested in it to build the best milling machine at the lowest cost. When this was done, their position would be impregnable, and the company could afford to and would be glad to pay high wages—the very highest going. The men were given envelopes to take home with them and were urged to make, in writing and by sketches or drawings, such suggestions as occurred to them concerning the work in the shop or the methods of management, and to drop the envelopes containing them into the boxes provided for that purpose. During the first six months twenty-one suggestions were received, and at the time we talked with Mr. Geier about the matter he said he expected more of them during the next six months, as he thought the men understood it better and more fully realized that every suggestion, no matter how seemingly trivial, if made in good faith, would be welcomed and considered. A prize had been, as a matter of fact, given to a man who suggested merely that the men be provided with individual soap boxes at the washing troughs.

Mr. Geier expressed the opinion that the day had gone by, if it ever existed, for the bludgeon treatment of shop men upon whose efficiency the success of a machinery manufacturing business must largely depend. He believed that the workmen in their shop were a lot of thoroughly good fellows who knew as well as anybody else when they were treated as men should be and when they were not. They had found that these men appreciated and responded to fair and liberal treatment, and they had, in fact, expected more good results from the suggestion plan by its effect in stimulating the interest of the workmen and in improving the general *esprit de corps* of the place than from the suggestions themselves, directly.

Time was when most patents contained from one to four claims, but the fashion now is to have all the claims possible, and patents with fifteen to twenty-five claims seem to be the rule; while in the United States "Patent Office Gazette" for September 4 there is a patent on a piano action that has 177 claims, filling over ten pages of the "Gazette." The object seems to be to say the same thing in as many different ways as possible.

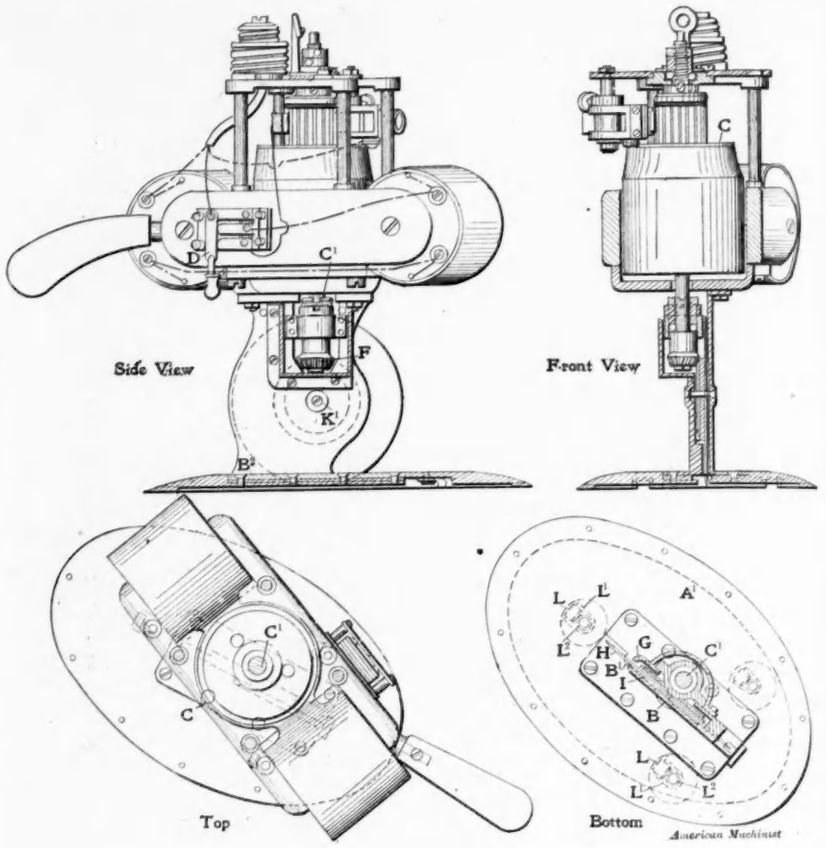


Fig. 1

ELECTRIC CLOTH CUTTER.

Tools for Interchangeable Work—III

BY JOSEPH V. WOODWORTH.

MAKING ROLLER PLATE AND ROLLER BRACKET.

The punches and dies and other devices described in these papers were designed for and put into successful operation in the manufacture of an electric cloth-cutting machine, the general features of which are shown in Fig. 1. It will not be attempted here to describe the machine.

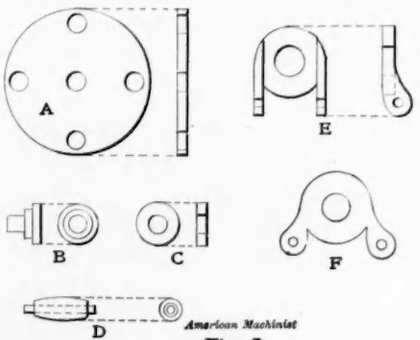


Fig. 2

ROLLER PLATE, BRACKET, ETC.

In Fig. 2 are shown sketches of the roller plate, and parts for the base described and shown in the first of these papers. *A* is the plate, 1¼ inches diameter, 3-32 inch flat cold-rolled stock, with five holes pierced in the positions shown; that is, the four outside ones coinciding with those in the base. *E* is the roller bracket, of the same thickness of stock, blanked, pierced and formed, to the size and shape shown, *F* being the result of the first operation. *B* is a small stud (made in the monitor) for fastening the bracket E to the roller plate *A*. *C* is a washer (made in the same way) to go on the back of the stud *B*, the end of which enters the center hole in the plate *A*, and shouldering against it; the washer *C* is then put on the end of the stud, and the same is upset, thereby riveting it tight and allowing the bracket *E* to swing free. The roller D is then put in between the two wings of the bracket, and the pin let in fitting tight in the bracket and free in the roller.

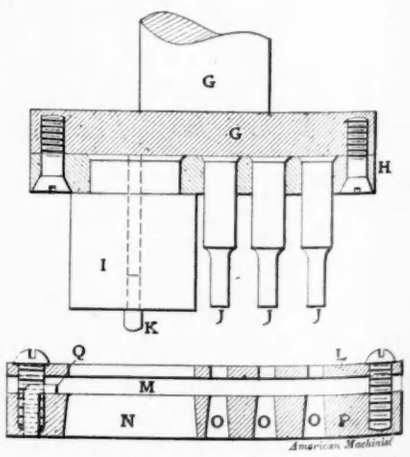


FIG. 3. PUNCH AND DIE FOR ROLLER PLATES.

The punch and die shown in Fig. 3 were for piercing the holes and blanking the roller plate *A*. *P* is the die, of tool steel, on which the piercing dies *O* were laid out from a template and drilled and reamed to size. The die *P* was then strapped on the face-plate of the lathe, and the blanking die *N* finished to size. After the holes for the stop-pin *Q* and for the screws for the stripper plate *L* were drilled and tapped, it was hardened and the face ground. The gage plate *M* and the stripper L were made, and the die was complete. The punch-holder *G*, of cast iron, and the pad *H*, of ½-inch flat machine steel, were then made, the pad being held by the flat-head screws shown. The holes for the punches were transferred through the die *P* to the pad *H* and drilled and reamed. The punches *I* and *J J J* were made, hardened, drawn and ground, let into the pad and upset in the back, as shown; the pilot-pin *K* made and let in to punch I; the parts assembled and set up in the press. The stock being fed from

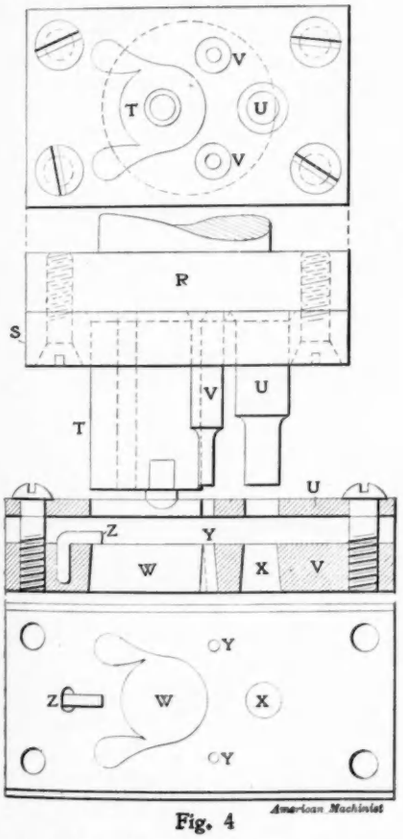


Fig. 4

DIE FOR FIRST OPERATION ON ROLLER BRACKETS.

the right-hand side, the five holes were pierced first, and the strip then moved along, the pilot-pin *K* centering it when it was blanked. As will be seen, the punch *I* is a thickness and a half of metal longer than the piercing punches J, so that it will enter the die and steady it while the holes are being pierced, which helps considerably.

Fig. 4 shows the punch and die, top and side views, respectively, for producing the blank *F* for the roller bracket *E*. In the first place a template of sheet steel was made to the exact shape and size, with the three holes shown in *F* in the proper position. The steel for the die having been prepared, the face was blue-stoned

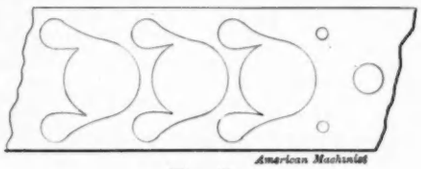


Fig. 5

STRIP OF METAL WITH BLANKS CUT OUT.

and two outlines of the template marked on it, dead in line with each other. The holes were then drilled through the template into the right-hand one for the piercing dies *X* and *Y Y*, which were then reamed from the back to size. The blanking die *W* was then carefully worked out

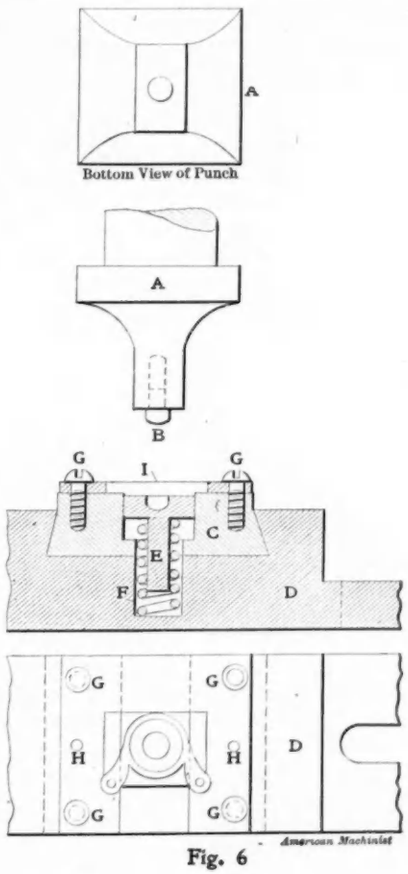


Fig. 6

DIE FOR SECOND OPERATION ON ROLLER BRACKETS.

to the lines, letting the blank just through at the top. The four holes for the stripper plate screws and the hole for the stop-pin *Z* were then drilled and tapped, and the die was hardened and drawn to a light straw, and the face ground.

The punch-holder *R* and the pad *S* were then made, and after the blanking punch *T* had been worked out and finished, by shearing through the die *W*, and the hole for the pilot-pin let in as shown, it was hardened and drawn to a blue, and let into the pad *S* and upset on the back. It was then entered into the die *W*, and the holes for the punches *V V* and *U* transferred through the die. They were then enlarged and the punches finished, hardened and drawn. They were driven in and upset. They were also left shorter than the blanking punch. The stripper and gage plates were then made; they were all assembled and put to work, producing a blank like *F*, Fig. 1. A section of stock punched is shown in Fig. 4.

The next and last operation is the bending and forming of the blank to the shape and size shown in *E*, Fig. 2. The punch and die used are shown in two views each, in Fig. 6. The punch, of tool steel, was first turned and the shank finished to size, and then chucked in the miller and milled to the size of the inside of the piece *E*, Fig. 2, allowing the cuts to run out as shown, the hole being drilled for the pilot-pin *B*. It was then hardened to about 1 inch from the face and drawn, leaving the back *A* dark blue and the face very hard.

The die consisted of a cast-iron bolster *D*, planed on the bottom and dovetailed at the top, to admit the die *C*, which was of tool steel, worked down and fitted (to the bolster *D*) with a groove, two thicknesses of metal wider than the punch, milled straight across and about ½ inch in depth. A hole was drilled in the center of the slot to admit the knockout *E* and the spiral spring F; two blocks of machine steel were then inserted, one at each end of the slot, to keep the knockout *E* steady. This knockout was made of tool steel, with a depression in the face to give clearance to the pilot-pin *B*. The upper edges of the die *C* were slightly rounded and the gage plate I worked out and fastened in position with dowel-pins *H H* and the four screws *G*. These were then removed and the die C hardened and just warmed, leaving it very hard. The spiral spring *F* was made, the parts assembled, the punch and die set up in the press, and the blank laid within the gage plate, as shown in the bottom view of the die, and the punch descending, the pilot-pin *B* entering the center, thereby holding the blank central and true while bending, and forcing it into the die; the punch ascending, the knockout *E* stripping the work from the die and delivering a piece the shape and size of *E*, Fig. 1, at each stroke.

Standard Pipe Flanges.

It will be remembered that at the December meeting of the American Society of Mechanical Engineers a report was received from the Committee on Standard Pipe Flanges. The Proceedings of this meeting, recently received, contain the committee's report and a table of the sizes adopted, which we reproduce herewith. This committee acted in conjunction with a corresponding committee of the Master Steam Fitters' Association, and the report

is the result of a large amount of investigation and deserves to be universally adopted. There is no minor field for standardization wherein the adoption of uniform dimensions will lead to greater satisfaction than this. Those only who have had to deal with the erection of steam plants and steam appliances are capable of appreciating the extent of the nuisance involved in the multiplicity of sizes of flanges now in use.

There are some things about the table which are not entirely clear, but by going back to a preliminary report of progress we find information which clears them up. Thus the formula for thickness which heads the second column, is intended for cast-iron pipe and the figures for thickness in the second and third column are for that material under 200 pounds pressure or less. The double sets of figures for flanges of pipe sizes above 24 inches, are intended, one for pressures of 200 pounds and the other for less, and the same observation applies to the two sizes of bolts.

The Trials of a Foundry Foreman.

BY C. VICKERS.

A company is formed to go into the business of brass founding. The leading spirit in the enterprise has discovered a new alloy of brass or bronze, or aluminum, or a new method of making solid copper castings, which he thinks is going to revolutionize the whole industry. They advertise for a foundry foreman, and ultimately decide upon a man, whom they engage and proceed to imbue with a portion of their enthusiasm, by telling him all about the wonderful properties of the metal they have discovered, how it has been tested and tried, and found far superior to all competitors, and consequently has a wide range of application, which will ensure for them an extensive business provided they can turn out the castings successfully.

We will suppose the new foreman is a thoroughly practical man of wide experience. His experience will have taught him that there are certain alloys that present insuperable difficulties to the founder, but he is naturally hopeful, and in view of the fact that some castings have been made in this particular metal, trusts that if any difficulties present themselves, he will be able to surmount them, either by devising methods of casting or modifying the alloy. He, therefore, enters into the business of equipping the shop, with an enthusiasm that keeps him working early and late, doing constantly more than one man's share of the hard work incident to getting out castings. He lays out the shop, giving the carpenters drawings and directions for making the molding tubs, core-benches, shelvings, pattern racks, etc., superintends and assists in the laying of the bricks which form the casting floor, builds the flue, and designs and lines up the furnaces, and even spends his own money in car fare traveling around the city interviewing the supply men, in order to obtain the best materials in the way of sand, flasks, furnace tools, etc., at the lowest possible figures. In the natural course of events, the new firm finds itself in readiness to commence molding and casting. A few trial orders are turned out, and then work comes in with a rush, for one of the shareholders is out on the road, ready like Don Quixote, to tilt at anything, and people with castings to make are not slow to take advantage of the fact that here they can get them made much cheaper and as good as anywhere, for the new firm is desirous of making its name synonymous with quality and is determined to turn out the best of work and the best of metal. The new alloy is lost sight of for a while. When they get thoroughly started will be time enough to turn their attention to that; meanwhile they are exceedingly busy. After a while they begin to figure and the result is startling. They are losing money and lots of it. They try to raise their prices and the customers naturally resist, saying they would never have transferred their work to them unless they could get it made cheaper than they were formerly doing. The truth is the new firm has been slashing prices, not wilfully, but through ignorance. The partners had neglected to take the pains to post themselves in advance and when bidding for work had named a price merely as a feeler, which may have been high or low, but was objected to by the desired customer on general principles. They would then ask the customer what he had been paying; he named a figure; they thought they must underbid that, so they got the work. The customer chuckled, the new firm got busy and hired more molders. So far it has been good for the customers and some few molders. After failing to increase the price of their work, the management turn to the foreman. He is made acquainted with the fact that the business is not paying, and it is evident to him that he is, to a certain extent, held responsible. He suggests using cheaper alloys. This advice is followed, scrap is used and the thing continues to run on. The manager, with a praiseworthy determination to discover whether there is any

Pipe size, inches.	Pipe thickness, $\frac{P+100}{.48S}\left(d+.333\left(1-\frac{d}{100}\right)\right)$ S-18,000 lbs.	Thickness, nearest fraction, inches.	Stress on pipe per square inch at 200 lbs.	Radius of fillet, inches.	Flange diameter, inches.	Flange thickness at hub for iron pipe, inches.	Flange thickness at edge, inches.	Width flange face, inches.	Bolt circle diameter, inches.	Number of bolts.	Bolt size diameters, inches.	Bolt length, inches.	Stress on each bolt, per square inch at bottom of thread at 200 lbs.
2	.409	7/16	460	1/8	6	1	5/8	2	4 3/4	4	1/2 5/8	2	825
2 1/2	.429	7/16	550	1/8	7	1 1/8	1 1/16	2 1/4	5 1/2	4	1/2 5/8	2 1/2	1,050
3	.448	7/16	690	1/8	7 1/2	1 1/4	1 3/16	2 1/4	6	4	1/2 5/8	2 1/2	1,330
3 1/2	.466	1/2	700	1/8	8 1/2	1 1/4	1 5/16	2 1/2	7	4	1/2 5/8	2 1/2	2,530
4	.486	1/2	800	1/8	9	1 3/8	1 5/16	2 1/2	7 1/2	4	5/8 3/4	2 3/4	2,100
4 1/2	.498	1/2	900	1/8	9 1/4	1 3/8	1 5/16	2 3/4	7 3/4	8	5/8 3/4	3	1,430
5	.525	1/2	1,000	1/8	10	1 1/2	1 5/16	2 1/2	8 1/2	8	5/8 3/4	3	1,630
6	.563	9/16	1,060	1/8	11	1 1/2	1	2 1/2	9 1/4	8	5/8 3/4	3	2,360
7	.60	5/8	1,120	1/8	12 1/2	1 1/2	1 1/16	2 3/4	10 3/4	8	5/8 3/4	3 1/4	3,200
8	.639	5/8	1,280	1/8	13 1/2	1 5/8	1 1/8	2 3/4	11 3/4	8	5/8 3/4	3 1/2	4,190
9	.678	11/16	1,310	3/16	15	1 3/4	1 1/8	3	13 1/4	12	5/8 3/4	3 1/2	3,610
10	.713	3/4	1,330	3/16	16	2	1 3/16	3	14 1/4	12	3/4 7/8	3 5/8	2,970
12	.79	13/16	1,470	3/16	19	2	1 1/4	3 1/2	17	12	3/4 7/8	3 3/4	4,280
14	.864	7/8	1,600	3/16	21	2	1 3/8	3 1/2	18 3/4	12	7/8 1	4 1/4	4,280
15	.904	15/16	1,600	3/16	22 1/4	2	1 3/8	3 5/8	20	16	7/8 1	4 1/4	3,660
16	.946	1	1,600	3/16	23 1/2	2 1/4	1 7/16	3 3/4	21 1/4	16	7/8 1	4 1/4	4,210
18	1.02	1 1/16	1,690	3/16	25	....	1 5/8	3 1/4	22 3/4	16	1 1 1/8	4 1/2	4,540
20	1.09	1 1/8	1,780	3/16	27 1/2	....	1 11/16	3 3/4	25	20	1 1 1/8	5	4,490
22	1.18	1 3/16	1,850	1/4	29 1/2	....	1 13/16	3 3/4	27 1/4	20	1 1 1/4	5 1/4	4,320
24	1.25	1 1/4	1,920	1/4	32	....	1 7/8	4	29 1/4	20	1 1 1/4	5 1/2	5,130
26	1.30	1 5/16	1,980	1/4	33 3/4	34 1/4	....	1 1/8	2	3 3/4	4 1/2	31 1/4	31 1/2	24	1	1 1/4	5 3/4	5,030
28	1.38	1 3/8	2,040	1/4	36	36 1/2	....	1 7/16	2 1/16	4	4 1/2	33 1/2	34	28	1	1 1/2	6	5,000
30	1.48	1 1/2	2,000	1/4	38	38 1/4	....	1 1/2	2 1/8	4	4 3/8	35 1/2	36	28	1 1/8	1 3/8	6 1/4	4,590
36	1.71	1 3/4	1,920	1/2	44 1/2	45 3/4	....	1 5/8	2 3/8	4 1/4	4 7/8	42	42 3/4	32	1 1/8	1 3/8	6 1/2	5,790
42	1.87	2	2,100	1/4	51	52 3/4	....	1 7/8	2 5/8	4 1/2	5 3/8	48 1/2	49 1/2	36	1 1/4	1 1/2	7 1/4	5,700
48	2.17	2 1/4	2,130	1/4	57 1/2	59 1/4	...	2	2 1/4	4 3/4	5 3/4	54 3/4	56	44	1 3/8	1 1/2	7 3/4	6,090

SCHEDULE OF STANDARD FLANGES.

Adopted July 18, 1894, by a Committee of the Master Steam and Hot Water Fitters' Association, a Committee of the Society of Mechanical Engineers of the United States, and the leading valve and fitting manufacturers of the United States.

money in the business or not, institutes a system of "red tape," the cost of which more than counterbalances any advantage that may have been gained by the introduction of the cheaper alloys. Each morning every molder is given a printed slip on which an attempt is made to keep track of every pattern he is working on and at night time he must count up his work and record it. This may be a good thing, but it costs money in molders' time, and the time of the man who makes out the slips. When the castings are cut off they must be weighed and each molder credited with the number and weight of his good and bad castings. This keeps another man busy counting and weighing and keeping each man's work separate. Then each individual heat of metal must be weighed and recorded before going into the crucible, and again weighed when the castings come out of the sand, in order to find out the loss in melting, and the result is never satisfactory, on account of the metal spilled in pouring and the temporary loss due to what adheres to the sides of the crucible. So, as far as practical results are concerned, this is all labor lost. Then the coke used must be weighed and tab kept on the crucibles. No wonder the laborers are kept busy and are to be seen going around the shop with a pencil stuck up under their caps, and a medical institute memorandum book in their hands keeping track, in their clumsy laborious way, of all the weighing and counting that must be done. The molders can get no help when they need it and must fetch and carry and help each other weigh and dump their own molds and "shovel in" and sieve their sand alone. No wonder they make less molds, for laboring work is more tiring than molding, for they are less used to it, and the more tired they become the slower they will mold, however willing they may be. The manager cannot see things in this light, however, but he can see he is not getting so much work turned out, and is not slow to ask the foreman the cause, who attempts to explain, but is met by the statement that he is too easy on the men; they are not working sufficiently hard, sometimes they are even seen away from their work. So the foreman has no alternative but to speak to the men. He does so with a heavy heart, for he understands the conditions and knows they have done their best. On their part the men are indignant, they have an abiding sense of injury, they cannot do better, for, handicapped by the laboring work, they have had to keep constantly working at pressure, in order to make a "showing" with their molds. So they blame the foreman and become dissatisfied and careless and the thing gets worse.

The manager now resolves to look after the shop more himself. Although he has no practical knowledge of the business, he thinks he knows how things should be done. He talks to the molders, shows them their bad work, tells them how he thinks it ought to be made, and suggests a "way." The molders, on their side, make excuses—the metal was too hot or too cold, it contained iron, or aluminum, or the sand is not good. One or two of them think they can see their foreman's finish, and perhaps they can get his job. So they throw out hints reflecting on his ability. The manager pretends to take no notice, but still such hints repeatedly thrown out and constantly growing bolder, taken into consideration with the fact that the business is evidently going wrong, probably turn the scale and the manager resolves to make a change. The foreman by this time is a thoroughly disgusted and discouraged man. He has lost the confidence of the men, and knows it, and the manager has interfered with his duties to such an extent that he possesses only the shadow of authority, as even the laying out of the work, and the distribution of patterns is his preogative no longer, for the manager has considerately taken this out of his hands and even blunderingly figures out the heats for the furnace-man. The foreman can do nothing to put things right, even if he had the power, for he has not the time, because he has been given patterns and must pound sand all day, just like the other molders, (this is an actual occurrence.) So he is not surprised when, a week or so later, the manager calls him to one side and gently and kindly, with many regrets, informs him that the stockholders have considered it advisable to make a change, etc., etc., and he is let out into the cold, and a new man assumes command in the shop that he has taken such care and pains to fit up.

And this is the reward that a foreman can expect in the majority of cases when he takes charge of a new shop. He feels an injured man, but he has no redress. All he can hope for is that in the eternal fitness of things, he may sometime attain another foremanship, stepping into a berth that some other man has prepared, even as he prepared this one for his successor.

A Strange Breakage.

The Whitney Manufacturing Company, of Hartford, Conn., maker of the Woodruff keys, has forwarded us a copy of a letter from the L. W. Pond Machine Company, which, together with the accompanying illustration, we reproduce below:

"The Whitney Manufacturing Company,
Hartford, Conn.:

"Gentlemen: We have your favor of the 13th inst., and enclose herewith drawing of shaft with dimensions showing location of break, and where shaft ground in the bearing. All we expected of the keys was to revolve the shaft and feed box, and we were surprised to find them powerful enough to break the shaft without damage to themselves or the gear teeth. The break in the shaft was a clean one, square with the shaft, and there were no flaws to start it. The shaft is 'Cambria' steel. The planer is a 30x30-inch with 19-foot table, and there were two tools cutting, with the table moving 20 feet a minute on the cut. The planer is run with a 3-inch belt, and the other data are contained on the drawing. The cause of the break was lack of oil. The long bearings of large diameter require more oil than the average man is disposed to give. Yours very truly,

"L. W. POND MACHINE COMPANY."

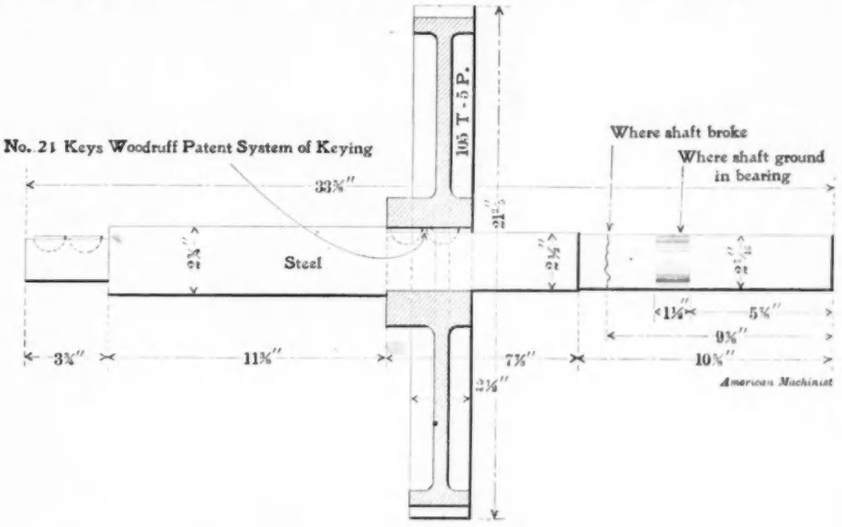


Fig. 1

THE SHAFT THAT BROKE.

Regarding this the Whitney Company say: "We believe this is a matter which will interest engineers, and it may be a problem that theoretical men may wish to explain, as we imagine the strain necessary to break the shaft must be greater than the shearing strength of the two No. 21 keys."

We have made a comparison of the strengths of the shaft and keys by the accepted formulas, and have obtained a very curious result. Of course we have no

knowledge of the actual properties of the materials of the shaft and keys, but the surplus strength of the shaft is so great as to far more than offset any possible difference in the materials.

After reducing to its lowest terms, the formula for the strength of a shaft in simple torsion becomes:

Resisting moment of shaft $= .1963\, d^3 S$, in which

d = diameter of shaft in inches,

S = shearing resistance per square inch.

Introducing the diameter of the shaft at the point where it broke, this becomes:

Resisting moment of shaft $= 2.84\, S$.

Again the

Resisting moment of keys $= a \times r \times S$, in which

a = shearing area in square inches,

r = radius in inches,

S = shearing resistance per square inch.

The No. 21 Woodruff key has a diameter of 1¼ and a thickness of ¼ inch. At the point of failure the length of the key is, closely enough for the purpose, 1 3-16

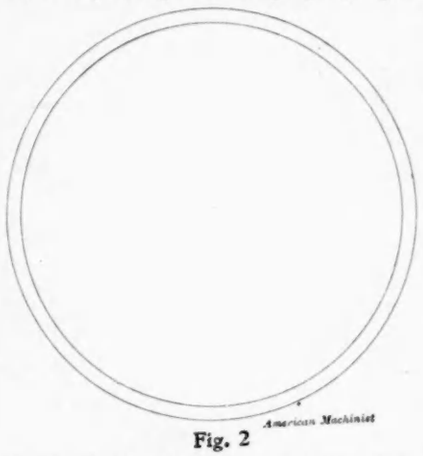


Fig. 2

SHEARING AREAS OF SHAFT AND KEY COMPARED.

inches, and as there were two of them, the total shearing area is $2\frac{3}{8} \times \frac{1}{4} = .594$ square inch. Substituting this and the radius we obtain:

Resist'g moment of keys $= .594 \times 1\frac{1}{4} \times S$,
$= .74 \times S$.

With the same shearing resistance the shaft should therefore be $\frac{2.84}{.74} = 3.85$ times as strong as the keys. Nevertheless, the shaft broke. Why is this thus?

The matter appeals most strongly to the eye if the shearing areas of keys and shaft are so laid out as to render comparison easy. For a short distance inward the fibers of the shaft may be assumed, without material error, to carry the same stress as the outermost fibers, and, neglecting the slight difference in the diameters, the shearing area of the key may then be laid down as a ring on the end view of the shaft. The result is shown in Fig. 2, in which the outer circle represents the shaft and the inner circle has been so drawn that the ring area between the circles equals the shearing area of the two keys.

Keys of the old-fashioned pattern, when well fitted and driven home, seldom shear off—not nearly so often as they twist the shaft in two, we think. This may be partly explained by reference to the additional holding power due to the friction between the shaft and the pulley or gear hub keyed upon it. With the Woodruff keys this can scarcely be much of a factor, as they cannot be driven in place like an ordinary key. When comparing these keys with the usual pattern, it will be noticed that those used in this case are much narrower than the usual rules for keys call for.

It is well known that where high speeds and the inertia of heavy moving parts are factors in the problem, such anomalies constantly present themselves, and that, in short, in such cases a calculation of strength gives little or no indication of where failure will occur. Such considerations do not enter here, however, and the only thing to do with the case seems to be to put it in Professor Sweet's classification of "the unexpected which often happens."

Echoes from the Oil Country—VII.

OUR APPRENTICES.

I have been much interested in watching our two boys, Sam and Joe. They are both good boys, in their way, and I could not well spare either of them; yet they are not alike in any way.

They have each been here a little more than a year, and can run the drill, pipe cutter and lathe about equally well.

Joe ran the pipe cutter very contentedly until he had mastered it, could grind up a flat or twist drill and do all sorts of drilling that came in, and is now taking up lathe work; but objects strongly to helping in the blacksmith shop or foundry.

Once after he had been helping the boilermaker, he came to me for a little talk; said he wanted to learn the machinist's trade, and thought there was more to that than he would ever get learned; he really thought if he got to be a first-class lathe hand he would have to put all his mind and energy into it for years, and that he would rather be king of the lathe than a mongrel at several trades or branches of one trade.

I tried to show him that all knowledge is useful, but seemed to make very little impression, as he reasoned that if he was not able to carry all there was to lathe work, it was useless to load up on a lot more in an endeavor to lighten his load.

He was a good, careful boy, a hard worker, and I could hardly understand his position, but resolved to keep him in the shop as much as possible. This was very easy to do—more so as Sam was quite willing to go anywhere on any occasion and tackle any kind of a job. I overheard him and Joe discussing the trade once, and the argument ran something like this:

"Don't you see, Joe, while I am helping tear that old boiler to pieces I am learning lots of things. I never knew before that a rivet hole had to be so much bigger than the rivet, or that the holes in an outside sheet on the shell had to be farther apart than in the inside one, or that the rivet being hotter than the shell when it was finished, helped to draw the sheets together and make them tight; or what a dome sheet looked like when it is straightened out; or what shape to cut a hole in a sheet, so it would be the shape it should be when the sheet was rolled."

"That's all right," said Joe, "but I don't see what good that is in learning the machinist's trade. You're not going to be a boilermaker, and I suppose you learned lots carrying iron in the foundry, too; didn't you?"

"You're just right, I did," said Sam, laughing. "I can tell molding sand when I see it and feel it, and whether it is wet enough to work good. I know a cope from the drag, and the difference between dirt and a blow-hole in a casting, and old Ben says that's more than most machinists know. He says machinists are about the dumbest lot that ever steps into a foundry anyway, and that they mostly think that a molder ought to use a micrometer on his cores and nickel-plate them, so there wouldn't be any sand to dull his tools, when all he has to do is to grind them and put them in their place and the machine does all the work while he sits on a box and growls because the molder left *any* work for him to do.

"I know how to charge the cupola and can tell when to pour the iron into the mold and why they make some gates higher than others.

"Do you know what makes that casting all lopsided? I do; that's because those flask pins you turned up were too loose in the holes."

"Old Ben said they were about ¾ inch diameter and I turned them that," said Joe. "If he wants to use them in ⅞-inch holes, that isn't my fault; I'm not running the foundry. And I suppose you learned lots striking for the blacksmith, too. You seem to be his pet, and he lets you play in the fire and spoil iron and steel for the Old Man, while he don't want me around at all.

"And that time you went out to help set up the engine and drove the team and dug the foundation hole and broke stone and mixed mortar and made a laborer of yourself generally, I suppose you were getting heaps of knowledge, such as it was; but I don't know what use you can put it to, boring out cylinders or turning up piston heads; and if you do, I would like to know, too."

Sam scratched his head for a minute in silence, and then said, slowly: "What would you do if you were away out in the woods on a job, and your last chisel would break off, and a bar of iron you had to use was 4 feet too long and had to have a hole in it, and the key you brought

wouldn't start in, and you hadn't any file; but there was a grindstone, and the men were waiting for the engine, and you didn't know how to dress a chisel or draw down a key?"

It didn't take Joe long to answer: "You wouldn't get me out at any such place; and if you did, I would know enough to get back to the shop without wasting any time."

Just then the whistle blew for 1 o'clock, and the boys got up from under the window where they had been sitting, and went in to work, while I tried to think out the difference in the boys.

I am young as a foreman, and perhaps my conclusions are wrong; but it seems to me that Joe learns each job as a separate exercise, studies the best moves to make, the most accurate measures to take, and memorizes that for future use or practices it in that way until he does it without having to think, and of course practice brings skill; but enough work of a similar kind is necessary to give considerable practice to give good results; and, from his standpoint, if he does not get that practice, he fails to reach the degree of proficiency he aims at.

Sam, on the other hand, learns principles; he seems to get the underlying basis that all the trades are built on, and likes to practice them, seeing his opportunity wherever work is to be done; and the more variety of work and conditions, the more chance to try different combinations, and you seldom find him doing a job twice the same way.

To my mind, Sam will be a mechanic machinist, while Joe will be a workman machinist.

Joe may make an expert foreman in some manufacturing shop, while Sam will be superintendent on new work.

Others may read them differently; time will tell. W. OSBORNE.

The Law of Averages—Simple vs. Compound Engines Under Variable Load.

BY W. H. BOOTH.

An enormous and successful business is carried out by life insurance companies because they are able to trade upon the uncertainty of life, which we are all persuaded attaches to the individual. Men insure their lives because they know that they may have but a short tenure. The insurance companies accept the risks of a hundred lives because they believe in the infallible law of averages, which tells them that year after year only a given proportion will die. There is nothing so sure as a number of lives; nothing so uncertain as one. The same law of averages applies to matters of engineering. What is so uncertain and irregular in operation as a single tramcar? In its journey it runs up hill, down hill, along a level, fast or slow, with no certainty or regularity whatever. One pictures with dismay the kind of load on the engine at the other end of the line. At one time there is no current being taken out of the line. At another possibly 60 amperes are swallowed up for a brief space of time. But this is for one car only. Add other cars and the range of duty is narrowed more and more. But no matter what the number of cars, the records of any system, month after month will show practically the same ratio of average load to maximum load, and for months of comparatively equal weather the same total current will be consumed and the same amount of current for each car mile run, despite all the various grades, speeds and other continually varying conditions. The doctrine of averages comes into play. No amount of mathematical ability will enable the results to be calculated beforehand. Further than this, tramway systems in different parts of the country and under different conditions as to service will show strangely similar averages; so much so that along certain lines one may fix from experience the future of hitherto unworked enterprises. I have no statistics of the engineering results of American tramways and so cannot speak to whether these averages observed here hold good there, but one thing has particularly forced itself on my attention and that is the very small ratio of maximum, to mean load on a station. Given a station running a certain number of cars and this ratio will be the same as for any other station with the same number of cars. The ratio holds good month after month and if a system be increasing and the number of cars be added to, it will be found that the load factor, or ratio of mean to maximum load, will also increase; correspondingly as it increases with the load factors of other stations as soon as the number of cars becomes equal. With a single car the ratio will be about 10 : 1 or 12 : 1, and will diminish to perhaps 2½ : 1 with 60 cars.

It is difficult, in fact impossible, to say how the variations are caused. There is a general tendency to find that car mileage per car is reduced as the number of cars is increased, and there is some kind of connection between the load factor and the units generated per hour or the number of cars. What concerns engineers, however, is that the engine load at the station is very variable and that if the engine can carry its load over the infrequently occurring maximum points it will be very much underloaded at the mean loading. It is probable that a practically steady load would not be attained until something like 500 cars and upwards were run on one system, that is to say from one power plant. This being so, there must be few systems that have not a poor load factor..

The almost invariable prime mover of a traction station is a compound steam engine. The usual ratio of its cylinder capacities is 3 : 1. It has an automatic cut-off and the largest dose of steam it can take is usually three-fourths of its small cylinder capacity. This corresponds with one-fourth of the larger cylinder. If the load factor is 25 per cent., it is clear that the average mean pressure referred to the large cylinder must be one-fourth of the mean pressure necessary to turn the maximum load. With, say 140 pounds gage pressure, the mean effective pressure at four expansions is 84 pounds. This is the maximum mean pressure we can employ in a compound engine referred to the low pressure cylinder. One-fourth of this is 21 pounds, which corresponds with about 22½ expansions. The minimum engine power is a mere fraction of the mean, and were it not for engine friction would represent about 200 expansions.

Now a mean pressure of 21 pounds is too small for economy, but it cannot be avoided because we have already made our engine only just sufficiently large to turn its load when using the maximum steam and the latest cut-off, practicable in a compound engine. Let it now be assumed that the high pressure cylinder is abolished and that steam can be admitted to three-fourths the stroke of the remaining larger cylinder. The expansions are now 1.33 and the mean pressure about 145 pounds.

A condenser is assumed throughout. One-quarter of 145 is 36, which corresponds with 12½ expansions. Now 12½ expansions is a good number; it is more than we should usually choose for a single cylinder engine, but it is better than 22½ expansions. We have already seen that with the same gage pressure of 140 pounds the mean pressure of the compound engine is 84 pounds while that of the simple engine is 145 pounds. But 84 pounds will, by our postulate, just turn the maximum load. Obviously, therefore, the simple engine may be reduced in size in the ratio 84 : 145 or say as 7 : 12. This is very closely the ratio of a 30-inch to a 40-inch cylinder of same speed and stroke, or as a 9½-inch to a 12½-inch cylinder or 16½-inch to 21½-inch. In order to adhere to the compound engine we find ourselves compelled to increase its size very much above that of the simple engine that will do the maximum load. If a 100-kilowatt engine has a 90 per cent. efficiency we throw away 10 kilowatts in friction. If we increase our engine in the ratio 12 : 7 we now throw away in friction 12-7 of 10 kilowatts or 17 kilowatts. That is to say, in order to have a compound engine we continuously waste 7 additional kilowatts. Ordinarily a small engine can be run at a higher speed than a large engine. In place of the 200 revolutions of the large engine we may run at 240, and the additional speed again varies the cylinder ratio of the two engines. In place of a reduction in size of 12 : 7 we may reduce in the ratio of 12 × 240 : 7 × 200, or practically as 28 : 14, that is to say to about half, or, in place of a 14-inch cylinder we can get our maximum duty from a 10-inch. Further still the increased speed of rotation enables a

smaller generator to be employed and it increases the effect of the fly-wheel.

It is well known that simple engines have greater stresses in their parts than have compound engines, and because of this it should be considered that the moving parts of the engine can be made lighter. They must be made strong because full boiler pressure comes on the low pressure piston. People who would not hesitate to put full boiler pressure upon the 20-inch piston of the high pressure cylinder of a compound engine will tremble at putting it upon the single piston of a simple engine. Yet the stresses are no greater. The simple engine requires parts not nearly so strong as the compound engine with the same size of initial cylinder. If a compound engine has cylinders of a ratio 3 : 1 the piston load on the high pressure may be called 1. At latest cut-off the forward pressure on the large piston will be ¼ and this will be the back pressure on the small cylinder also. The net pressure on the crank-pin from the small piston will be $1 - \frac{1}{4} = \frac{3}{4}$. That on the crank pin from the large cylinder will be $\frac{1}{4} \times 3$ or again ¾. The total crank pin pressure will be 1½. A simple engine of equal size will have a piston load of 3, but for our purpose the piston area may be halved so that the ultimate crank pin load is as before 1½. These figures are, of course, rough and approximate, but they point to the necessity of keeping the moving parts about the same for simple or compound engines designed to do a maximum duty at maximum cut-off in each case.

If it be granted that in the instance given there is an advantage with the simple engine, it is evident that there must be some point or line of demarcation that marks the division between the field of the two types. This line is, of course, marked by some value of the power factor and as this factor is smallest in the case of systems with small output, it is plain that if the simple engine is to be preferred it will be at its best in the small powered stations. For steady loads I do not think there is much question as to the general superiority of the compound type of steam engines. There are two points in electric traction work which detract from that superiority. One is the question just debated of variable load and the other is superheat. The first or variable load, as we have just seen, compels us to employ an engine twice as large as would drive the mean load, in order that it may be able to cope with a rarely occurring short period of maximum and excessive load. In other words, compound engines are of necessity much too large, and therefore wasteful. Hence the reason why an engine is not helped with its duty until it fails to turn round with its maximum load without excessive slowing down.

If it were not for the well known phenomenon of cylinder condensation all steam engines with equal pressure and expansion would be equally economical. The best remedy for cylinder condensation is superheat, and superheating is becoming more common in traction work and should, therefore, militate in favor of the simple engine. In the foregoing, I have made no claim to the superiority of either simple or compound engines because I have no definite or sufficient data to found my arguments upon. I see plainly, however, that small load factors do deprive the compound engine of some of its superiority. The question is, of course, of how much? I suggest that all its superiority disappears under conditions of frequent occurrence in tramway work; that probably compound engines will not justify themselves unless on large systems.

I should be glad to hear of any source or publication in which I may find the load factors and output and number of cars on American tramway systems, a system being not necessarily the whole of a tramway system, but such part as is throughout in electrical connection, the power factor being strictly dependent upon the amount of power and the number of cars run off the source of power. Conditions of convenience and break-down may sometimes render it desirable to divide a system of tramways into two or more independent systems. From the point of view of steady load this cannot be defended, because approximately the factor varies with the cube root of the inches generated in a given time. Cutting a system into two equal halves reduces the power factor approximately in the ratio $1 : \sqrt[3]{2}$.

We do not know really what is the proper proportion of engine power to employ. That is to say, we do not know if the best economy is secured when the engine is loaded to its economical load at times of mean output. The smallest possible compound engine of ordinary cylinder ratio usual in traction work is fairly economical at the brief periods of maximum load. Both the simple and the compound engine are unquestionably very uneconomically worked at minimum loads, when the power factor is small.

The simple engine is wasteful at the full steam admission of ¾ stroke when struggling over its maximum load peak. But this maximum is of brief duration and there are long periods when the ammeter needle does not go very far from mean output, and in the case chosen it seems probable that simple working will prove the better quite apart from considerations of space, first cost, etc., and that moderate superheat will assist to the same end.

The Metric System.

Sir Douglas Fox, on assuming the presidency of the Institution of Civil Engineers, said: "The question of the adoption of the metric system has been ably dealt with by others. I therefore only desire to record my opinion that it is of the utmost importance to the engineers and traders of this empire, that this simple and effective mode of measurement, already in force in almost every other civilized nation, should be introduced here. Having had occasion for many years to work under both systems, I can bear testimony to the great saving of time and of labor effected by the use of the metrical weights and measures, and to the ease with which the system is acquired, even by those trained to use our antiquated and complicated standards. I am strongly of opinion that the two great Anglo-Saxon nations, Great Britain and the United States, must fall into line with the rest of the world in this matter, and it would be a notable and interesting mark of our entry into a new century if, as has already been suggested to our government, the metric system could be made compulsory as from A. D. 1900. One great obstacle to British designs and manufactures finding their way upon equal terms through the Continent of Europe, and into the vast empire of China, Japan and elsewhere, would thus be removed, and engineers throughout the world would be thinking and designing upon a basis of like dimensions."

These are the words of a man who has had a very large practical experience in engineering work, and whose opinion on this matter is evidently based upon extended use of both systems of weights and measures.

Switchboard Instruments—Integrating Wattmeters and Ammeters.

BY WM. BAXTER, JR.

Ammeters indicate the strength of the electric current, and voltmeters indicate the electromotive force, or voltage, which is also commonly called the electrical pressure. Neither one of these instruments, however, gives any indication of the amount of power in the circuit. In steam engineering, the steam gage is the counterpart of the voltmeter, and a meter that indicates the cubic feet of steam flowing through the supply pipe would be the counterpart of the ammeter. If we multiplied the readings of the gage and the meter, we could determine the power value of the current of steam flowing through the pipe, and in like manner we can determine the power in an electric circuit by multiplying the readings of the voltmeter and the ammeter. The product of these two gives us the power in watts. It is clear that in the case of steam, an instrument could not indicate the power unless it was so constructed as to be controlled by the pressure as well as the quantity of steam, and this conclusion also applies to an electrical instrument capable of indicating watts.

Direct-reading wattmeters are the same in general appearance as the ammeters and voltmeters, being provided with a pointer which swings over a scale, the divisions of which indicate the number of watts. All such instruments are constructed upon

the electro-dynamometer principle, which was explained in an article on ammeters and voltmeters, published in issue No. 10. As will be remembered, the electro-dynamometer consists of two coils through

FIG. 1. THE THOMPSON INTEGRATING WATTMETER.

which the current passes, and the reaction of these toward each other causes the pointer to move. When the instrument is to indicate watts, the main current passes through the stationary coil, this being connected in series in the circuit. Through the moving coil the current is that due to the voltage, the ends of the coil being connected with the two terminals of the generator, in the same manner as the voltmeters are connected. In the stationary coil the current variations are the same as those of the main current, since this coil is part of the main circuit. In the movable coil the variations in current strength are proportional to variations in the voltage. From this it will be seen that the magnetic force developed by the stationary strength of the main current, and that the magnetic force of the moving coil will vary with variations in the voltage. Now both these forces act together to produce the deflection of the pointer, therefore the position of the latter will represent the combined effect of the change in current strength and the change in voltage; or, in other words, it will indicate the power in the circuit, since this is equal to the combined effect of the current and the voltage.

Indicating wattmeters are a convenience, since they enable us to ascertain at a glance the power that is being developed at the moment, but this is variable, and on that account the average output cannot be ascertained, except approximately, by means of an indicating wattmeter; and even to obtain an approximation it is necessary to take frequent readings of the instrument. By means of an integrating wattmeter, the average power can be readily ascertained, for this type of instrument shows the total amount of energy that has passed through the circuit in any given interval of time. Intcgrating wattmeters are simply small electric motors that drive a train of registering wheels which move pointers on dials similar to those used in gas meters, or else rotate disks that have numbers printed upon their peripheries, as in the various types of counting machines. The power developed by the motor part of the instrument is applied to operating a small electric generator or some other suitable retarding device, and the two parts are so proportioned that the velocity of the motor is directly proportional to the power developed in the circuit at that instant. Integrating wattmeters adapted to alternating currents are very simple in con truction, owing to the fact that with these currents the motor part can be made without a commutator. Such construction is not possible for continuous-current instruments, hence integrating wattmeters of the latter type are more complicated.

Fig. 1 shows the general appearance of the Thompson integrating wattmeter. The motor part is located at the top. The two coils parallel with each other constitute the field, and develop the magnetic force that causes the armature within them to rotate. The vertical shaft carries the armature and commutator at the upper end, and a disk at the lower end. This disk forms the armature of the generator part of the instrument, while the three bars that are bent into a "U" form, with their ends close to the sides of the disk, form the field magnets of the generator. The location of these parts, as well as the course of the currents through the coils, can be better understood from Fig. 2, which is a vertical elevation of the motor part and of the armature and one of the field magnets of the generator. In this figure, *F F* are the field coils of the motor, and *A* is the armature. The commutator *C* is located at the upper end of the shaft *S*. The whole current that is measured by the instrument passes through the field coils *F F*, but through the armature *A* the current is very small. The wires *b b* connect the commutator brushes with the two line wires, so that the current passing through the armature is proportional to the voltage of the circuit. The wire wound upon *A* is very fine, so as to make its resistance high, and thereby reduce the current strength to the lowest point. As the field coils *F F* are in the main circuit, if the current increases, they develop a stronger magnetic field to act upon the armature *A*, and thus increase its power, and in that way its velocity. If the voltage in the circuit increases, the current flowing through the armature will increase, and this will also increase the power, and thus the velocity. From this it will be seen that an

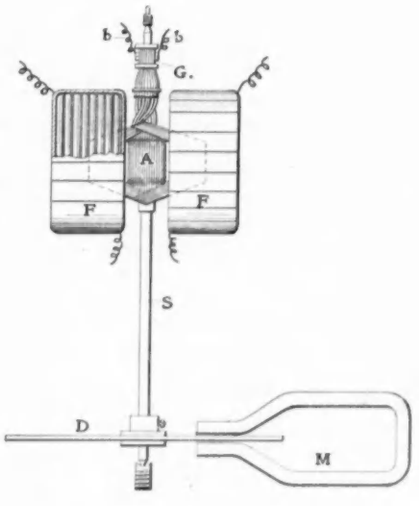


Fig. 2

CONSTRUCTION OF THE THOMPSON INTEGRATING WATTMETER.

increase in either the strength of the current in the circuit or its voltage will cause the motor to rotate with a greater velocity. In the same way a decrease in current or voltage will cause a reduction in the velocity of the motor armature.

The generator part of the instrument consists of the disk-shaped armature *D*, which is simply a circular piece of sheet copper, and three permanent magnets of

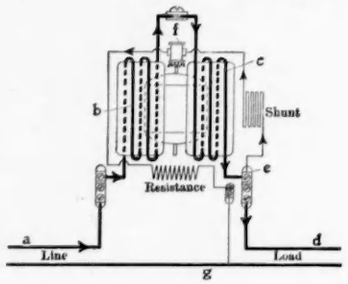


Fig. 3

CONNECTION OF WATTMETER TO THE TWO-WIRE SYSTEM OF DISTRIBUTION.

the form of *M*. By the rotation of *D* between the poles of these magnets, electric currents are developed in it, and the strength of these, as well as their voltage, depends upon the velocity of rotation, so that if the shaft S turns slowly, the currents developed in *D* are weak, and if it turns rapidly, these currents are strong. It will thus be seen that while the power of the motor at the upper end of the shaft *S* is increased, by increases in the voltage or strength of the current that is measured, the tendency of this increased power to develop a higher velocity of *S* is opposed by the action of the generator armature *D*, as the resistance with which this opposes rotation increases with the velocity. Since the tendency of the motor to increase the velocity is counteracted by the tendency of *D* to resist an increase, it follows that by properly proportioning the two parts, the motor can be made to predominate over the generator to as great an extent as may be necessary to allow the velocity to increase at a rate that is directly in proportion with the increase in the power being developed in the circuit at any particular instant; hence, by properly proportioning the motor and generator, the velocity imparted to the train of gears that moves the registering hands upon the dials in Fig. 1 will be such as to give a true indication of the energy that passes through the coils *F F* and armature *A*.

Figs. 3 and 4 show the way in which this wattmeter is connected with the circuit wires, and from the nature of these connections its action will be still further illustrated. The first diagram shows the way in which the connections are made for a two-wire system of distribution, while the second represents the connections for the three-wire system. In Fig. 3 the field coils are connected in series in the upper main line, the current flowing in the direction indicated by the arrow heads. Starting from *a* the current passes to field coil *b*, thence through the other field coil *c*, and to the line again, at *d*. The current that passes through the armature is taken from the upper main line at *e*, and after passing through a regulating shunt reaches the commutator *f* and through this the armature coils. Having passed through the armature coils, it reaches wire *n*, and finally the lower main line *g*. From this it will be seen that the current passing through the field coils *b c* is the whole current in the main circuit, and therefore the strength of the field of the actuating motor will vary with the changes in the current strength. On the other hand, the current passing through the coils of the armature is derived from the two circuit mains, and therefore is varied by changes in the voltage.

In Fig. 4 the instrument is connected so as to measure the energy in a three-wire system. In such a system the current passing from the generator through main *a* will return through *g*, if the system is perfectly balanced; but if not, there will be a current flowing in the central main, which is called the neutral wire. The power developed by such a system at any instant is equal to the sum of the products of the currents in each of the wires *a* and *g* by their respective voltages. From this fact it will be seen that as the current in main line *a* passes through field coil *b* and the current in main line *d* passes through field coil *e*, the strength of the motor field is proportional to the sum of these currents. The armature coils are connected between the point *h* of wire *d* and point *p* of the neutral wire; hence the current through the armature will be proportional to the voltage between *d* and the center line, and this is practically the same as the voltage between the center and *a;* therefore the indication of the instrument will be proportional to the total amount of energy passing through the three wires.

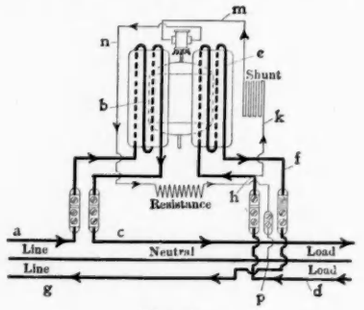


Fig. 4

CONNECTION OF WATTMETER TO THE THREE-WIRE SYSTEM OF DISTRIBUTION.

Fig. 5 shows another form of integrating instrument adapted to continuous currents. It is not a wattmeter, but serves practically the same purpose. It indicates the strength of current, and by multiplying the reading by the voltage the watts can be obtained. If the current in the circuit is weak, the registering apparatus runs slowly, and if the current is strong, the registering mechanism runs rapidly. Instruments of this type are called ampere-hour meters, and they give a reading that is equal to the strength of current multiplied by the time. If at one time the current is 100 amperes and at another 90, and it varies within these limits, it is evident that in the long run it will be equivalent to a uniform current of a strength somewhere between the two extremes. If the instrument is adjusted to indicate ampere hours the product of the reading by the voltage will give the number of watt-hours of energy, and if the variation in the voltage from time to time is small, this product will not be far from the true amount of energy. Ampere-hour meters can thus be used to measure the energy delivered to a circuit providing the voltage remains approximately constant; but if it is subjected to frequent and wide variations, they cannot; in such cases the only instrument that will give accurate indications is the wattmeter.

The instrument shown in Fig. 5 is of English make and is interesting, not only on account of its simplicity and accuracy, but also because it is the invention of Lord Kelvin, who is the leading authority of the day on electrical science. Its operation will be understood from the following description:

The solenoid *a* is connected in the circuit whose current is to be measured. A soft iron plunger is drawn down into this coil by the attractive force and is held up by the tension of the spring *b*, which latter is supported at its upper end by a scale beam *c*. The spring *b* and the beam *c* are used to adjust the resistance opposing the downward pull of *a* to such an extent that the distance through which the plunger is depressed is proportional to the strength of current flowing through *a*. The plunger is guided by two rollers, one of which is attached to the rod *d* and the other to the train of gears connected with the registering dials. At regular intervals of time, say every minute, the rod *d* is pressed to the left by a cam attached to the wheel *h* and immediately following this depression the lever *e* is raised by a crank which is also rotated by wheel *h*. The upward motion of *e* raises the plunger out of solenoid *a* and while the latter is moving upward the rollers between which it is guided revolve. In this way at each upward movement of the plunger, the registering mechanism is set in motion. The rod *e* always lifts the plunger to the same hight, but as the solenoid pulls it down to a point that is proportional to the strength of the current, the distance through which the plunger is lifted is not the same each time it is raised, but varies with the strength of the current at the time of each movement. From this explanation it will be seen that the movement of the hands upon the dials is not continuous, but periodical and that the angle through which they are advanced at each movement de-

pends upon the strength of current at that particular time, thus the indication of the instrument is the result of successive measurements of the current taken at very short intervals of time.

The wheel *h* is rotated by the force of gravity, a weight attached to *d* being suspended from a drum which is secured to the wheel. This drum is held by means of a clutch which holds the drum and wheel together when the weight is descending, but releases the drum when the weight rises. The weight moves within the cylinder located below *i*, and each time it descends to a certain point an electrical connection is made that cuts into circuit *a* solenoid at the upper end of the cylinder, and this lifts the weight to the upper

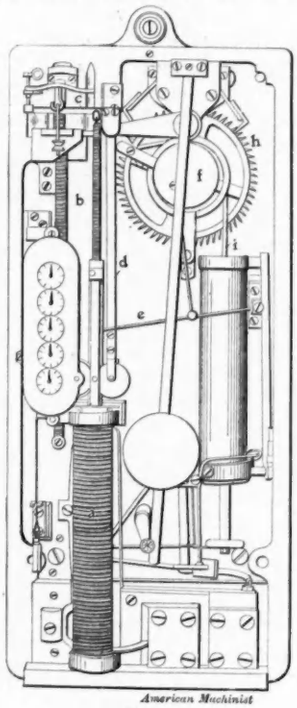


Fig. 5

WORKING PARTS OF AMPERE-HOUR METER.

position. The regularity of motion of wheel *h* is obtained by means of an escapement, which is under the control of the pendulum clearly shown in the engraving.

The above type of instrument comes nearer to a gas meter than any other form of electrical meter. It measures the quantity of current. A wattmeter measures the quantity and also the pressure, giving the product of the two.

Wattmeters, as a rule, are set to indicate kilowatts, one kilowatt being equal to 1⅓ horse-power.

Machine Tool Trade in Spain.

BY J. H. BALL.

An omission of considerable importance in reckoning the possibilities of extended trade with the Spanish market, occurs in the article on this subject by H. L. G., published in the "American Machinist," No. 22. Spain is a country whose currency is much depreciated and the exchange places a very heavy impost on all goods imported, in addition to the duty levied by the custom-house and the very heavy freights and shipping charges. The Spanish peseta, therefore, instead of being the equivalent of a franc, becomes of much less value when it has to be converted into francs, pounds sterling or gold dollars. The present rate of exchange is about 27 per cent., although it is lower now than at any time since January, 1898. Under these circumstances, and assuming the average cost of freight, duty and charges at 20 to 25 per cent. (a fair estimate), a total difference of about 50 per cent. stands added to the price of all machinery imported; and the country being among the poorest of European nations, this handicap is too severe for any but the very largest and wealthiest concerns. These, moreover, are mostly in the hands of British, French or Germans, and of course blood is thicker than water.

The difference in cost is especially notable in the case of small machine tools of high original price, rendering it practically impossible to find sale at the cost price of import, and so prohibiting importation altogether. Now and again a big firm will go for a foreign tool in the shape of a big boring mill, planer or wheel lathe, but the remaining tools imported are usually of the very cheapest class, price being then of more importance than quality. Labor is so cheap and plentiful that in most cases it is cheaper to take longer on the work than to go to the expense of a really good modern tool.

Further, the extremely peculiar and offhand way in which Spain is "thrown in" with the district of some agent in Paris, Berlin or elsewhere far enough away, and the strange ideas of several of these agents concerning this country, do not tend to push the trade; catalogs in German, French or English not being of much use to those who do not understand any but their native tongue. One of these continental firms wrote a friend of mine recently: "We have no faith whatever in Spanish trade, and prefer to be without orders from that country." Now the sequel: When in England recently I bought three or four American tools, and among them a lathe which gives such good results that one or two other manufacturers wish for similar lathes. But the London firm of agents who supplied the first, wrote in reply to the inquiry for terms: "We send you catalog; but regret that we cannot quote you prices, as Spain is in Blank & Company's district." Blank & Company are the firm who "have no faith in Spanish trade," etc., and who never visit the country; yet they have the sole agency for Spain. This to me does not seem clever.

I believe I am justified in saying that there is not in all Spain one single depot of *modern* machine tools. Here in Catalonia the nearest approach to it is a small concern run by a couple of British, making very light tools copied from British or United States models, such as power hack-saws and sensitive drills; who also do a good deal of bright screw-making, and who, having a small but up-to-date plant, make a point of showing their outfit to all comers and so getting a few orders for machines similar to those shown at work, or for any others that they may find opportunity to introduce. There are plenty of "runners," or Spanish travelers on commission, who try to sell from English or German catalogs; but as their lack of practical knowledge of machinery is unleavened by even a reasonably decent acquaintance with either English or German, the results are rarely satisfactory. At long intervals come a representative or two of English or German houses, who sell an occasional tool as an accessory to their file or steel trade; but their turnover in tools would not, by itself, pay the very moderate expense of a Spanish journey. On the other hand, there are always plenty of copies of old-pattern English lathes, planers, shapers, etc., to be had fairly cheap, many of them with English names on, and which are sold to the confiding Spaniard as just arrived from England. In these cases the actual manufacturer and the buyer sometimes meet afterwards, and then there is some fun.

The impossibility of finding a market for any number at a time of any one article, in a country so poor and illy organized as is Spain, has much to do with the general reluctance to order expensive or special machine tools. Nobody works for stock, but only to order, and then on anything from a needle to an anchor. The favorite tools, therefore, are the 15 to 20-foot gap lathe and the 12 to 15-foot planer, as being tools for which there is always work, and even though it is only a 3-inch stud, it will be made on that 15-foot lathe.

The Catalan, the hardest worker in all Spain, is the first to admit the extent of his backwardness in tool matters, and will take shame to himself that he is one of so behindhand a nation; but it is not safe to accept this entirely as gospel, any more than his ready invitation to you to look on his house as your own. Both are forms of exaggerated courtesy to the stranger. But he has the firm belief that every foreigner who understands machines at all knows more than any resident Spaniard possibly can, and, while frequently too occupied to see the Spanish "runner," will never refuse an interview to a foreigner, especially if he be English, German or American, and such foreigner may always rely on receiving perfect courtesy and careful attention; but in his prices and in his expectations of results he must always remember that confounded rate of exchange.

The Spanish mechanic or workman is, as a general rule, as intelligent, steady, honest and industrious as one can wish,

and he never gets drunk. Given decent treatment, he is very docile and quick to learn, taking a keen interest and great pride in the use of any machine that is more up to date than the general run; and I have it from the British representative of one of the greatest United States firms, that he has never seen their big boring mills better used than by Spanish mechanics in Barcelona. Naturally, the Spaniard lacks experience in modern practice, as his best machinery is nearly all of thirty to fifty-year-old style. He rarely has any small tools besides a pair of big calipers and a folding wooden measure, a meter long; but he is keen on something better, and there is a good and large market for hand tools, etc., such as Brown & Sharpe, Starrett and others have made familiar, and indeed indispensable, in the rest of Europe. All rules, etc., must be metric, or, better still, metric and English. Whitworth screw threads are almost universal, and are known as "English" thread.

In the "American Machinist" No. 30 is a paragraph referring to Spanish patent law. The Spanish law takes no stock whatever in the actual inventor of an article or process, in what is known as a "patent of introduction." The first person to begin a new process or manufacture in Spain, of any article not hitherto made there, can get a five years' protection by patent. The statement that a principle can be patented is only applicable to a real bottom patent. Infringement of patent is a criminal action, and on application to the judge, the infringing goods can be seized by the court without previous notice to the infringer; but the prosecutor must stand the racket if his case fails afterwards. The courts have the reputation of being notoriously venal, but my own experience does not bear this out. Further, a patent can be upset or defied with success if it can be proved either that *bona-fide* manufacture had not taken place within two years of date of patent, or had definitely ceased at the time of the alleged infringement—though this being a civil case may mean a long and expensive fight.

One more note to American manufacturers: Nicely gotten up catalogs *are quite useless without prices* (and to send them so is the rule and not the exception); and lastly, there are very few Spaniards who understand any language besides their own. *Verb. sap.*

Barcelona, Spain.

Table for Spacing Holes in Circles.

BY F. W. SEIDENSTICKER.

Last year while working for an electrical concern I made a table for sines, which is somewhat more comprehensive than the one published by G. A. H. in the "American Machinist," No. 31. It was used for finding the thickness of commutator bars and also for calculating the chord for spacing the slots in armature punchings. The table of sines given in Trautwine was used for calculating, and the table is correct, with possibly an error of 1 in the last decimal place. The angles as well as the sines are given, and although I have not found any use for the angles up to now, they were put in as I had to have them to calculate the sines, and they might come in handy some day. This table has been photographed, copies being handed to fellow workmen, and I enclose a copy for publication. It may interest G. A. H. to know that a similar table is given in the hand-book published by the Stillwell-Bierce & Smith Vail Company, but which runs up to 200 sides only.

Chicago, Ill.

Purdue University entered upon a new school year on Wednesday, the 12th inst., with a larger number of students in attendance than ever before in its history. The enrollment of the Freshman class was approaching close to 300 on the second day, with many new students yet to be matriculated. The number of Freshmen will reach 350, and the total enrollment for the year will exceed 1,000. It is significant that the increase in the attendance is very largely within the schools of engineering. Preparations have been making during the summer in anticipation of a large attendance, and laboratory equipment in many departments has been increased.

Letters from Practical Men

Noise Gages and Dirt Gages.

Editor American Machinist:

And so Mr. Tecumseh Swift wants a noise gage and a dirt gage, but denies, and rightly to, the necessity of a smoke gage; maintaining that smoke is an unnecessary accompaniment of the combustion of fuel, consequently a gage for the measurement of that which should not exist would be a superfluity. He very pertinently remarks that the noise in and about an ordinary machine shop is a good index of the shop and of the men responsible for its management. I dare say were he to enter the shop where the loose pulleys were clattering against the tight pulleys on every countershaft and the line shaft groaning and thumping like a propeller shaft in a high sea, he would immediately say that any machine built in such a shop would, by all the laws of heredity, develop in an early stage of its existence the multitudinous creaks and groans and clatterings among which it had its origin; and he would be right. No good sound mechanical superintendent will endure such glaring advertisements of somebody's inefficiency; and no good manager will employ, for any length of time, a superintendent or foreman who will permit such things to exist in his shop.

I very distinctly remember, in my early days of shop experience, a job which consisted, in part, of reboring the cylinder and making a new piston for an air compressor; and there being no boring bar at hand the man to whom the job was allotted proceeded to make one. It was an ordinary cast-iron head about 10 inches in diameter with inserted cutters, and in due course of time it was completed and the process of reboring commenced. Simultaneously there commenced a series of unearthly shrieks and groans, which made ordinary conversation impossible anywhere in the shop. This state of affairs continued throughout the entire process of reboring this cylinder, which was something like 18 inches in length, and we can readily see that had Mr. Swift been responsible for the mechanical matters in that shop, not only the boring bar but the man who made it would have gone through the window into the mill race.

If I may be permitted, I would class the dirt gage with the smoke gage, as being an unnecessary appliance so far as mechanical shop practice is concerned. I recall a certain shop which was the mechanical end of a large corporation, and was used to supply such new tools as were required in the course of their work and to keep the old ones in good repair. After this shop had been in existence a number of years there came as superintendent a young man, whom we will call Brown, and who might by others have been called Green, from the fact that he was fresh from college, if for no other reason. Shortly after his appearance on the scene he started a crusade against dirt and rubbish, and with the aid of two or three laborers carted away from the shop and yards a wagon-load of overalls, jumpers, shoes, hats and enough scraps from the noonday meals to furnish employment for a garbage crematory for a week. Then he had the carpenter build a bin in one corner of the yard, which was roofed over and fitted with a door, made in sections, which could be successively inserted as the bin filled. Then there was a box constructed which fitted underneath each lathe, and others of various shapes and sizes for milling-machine, shaper, planer, drill-press, etc., after which he sawed in two a half dozen empty oil barrels, which were painted a bright red and on which was inscribed in large white letters the legend "Refuse;" these were located in convenient places about the yard. A laborer was selected and given an outfit consisting of broom, rake, shovel and wheelbarrow, and to him was assigned the task of raking up and wheeling away all litter from the yard; also once a day cleaning out the the chips and scraps from the various boxes around the machine tools and depositing them in the above mentioned bin, and at least twice a week he went the entire length of the line shaft, with a crotched stick, to which was attached a piece of emery cloth. This latter device kept the line shaft as bright and clean as the day it was installed, and the result was that every machine hand at once fell into the

TABLE OF SIDES-ANGLES & SINES

MULTIPLY DIAMETER BY SINE TO GET LENGTH OF SIDE. ANGLE IS HALF OF ANGLE SUBTENDED BY SIDE AT CENTER

No. Sides	Angle	Sine	No Sides	Angle	Sine
3	60°	.8660254	45	4	.0697565
4	45°	.7071067	46	3-54-46.95	.0682423
5	36°	.5877852	47	3-49-47.23	.0667926
6	30°	.5000000	48	3-45-	.0654031
7	25°42'-51.42	.4338837	49	3-40-24.49	.0640702
8	22°-30'	.3826834	50	3-36-	.0627905
9	20-	.3420201	51	3-31-45.88	.0615609
10	18-	.3090170	52	3-27-41.53	.0603784
11	16-21-49.09	.2817325	53	3-23-46.41	.0592405
12	15-	.2588190	54	3-20	.0581448
13	13-50-46.15	.2393157	55	3-16-21.81	.0570887
14	12-51-25.71	.2225208	56	3-12-51.42	.0560704
15	12	.2079116	57	3-9-28.42	.0550877
16	11-15	.1950903	58	3-6-12.41	.0541388
17	10-35-17.64	.1837495	59	3-3-3.05	.0532221
18	10-	.1736481	60	3-	.0523360
19	9-28-25.26	.1645945	61	2-57-2.95	.0514787
20	9-	.1564344	62	2-54-11.61	.0506491
21	8-34-17.14	.1490422	63	2-51-25.71	.0498458
22	8-10-54.54	.1423148	64	2-48-45	.0490676
23	7-49-33.91	.1361666	65	2-46-9.23	.0483133
24	7:30-	.1305262	66	2-43-38.18	.0475819
25	7-12-	.1253332	67	2-41-11.64	.0468722
26	6-55-23.07	.1205366	68	2-38-49.41	.0461834
27	6-40	.116 0929	69	2-36-31.30	.0455145
28	6-25-42.85	.1119644	70	2-34-17.14	.0448648
29	6-12-24.82	.1081189	71	2-32-6.76	.0442333
30	6-	.1045284	72	2-30	.0436194
31	5-48-23.22	.1011683	73	2-27-56.71	.0430222
32	5-37-30	.0980171	74	2-25-56.75	.0424411
33	5-27-16.36	.0950560	75	2-24-	.0418757
34	5-17-38.82	.0922683	76	2-22-6.31	.0413249
35	5-8-34.28	.0896392	77	2-20-15.58	.0407885
36	5-	.0871557	78	2-18-27.69	.0402659
37	4-51-53.51	.0848058	79	2-16-42.53	.0397565
38	4-44-12.63	.0825793	80	2-15-	.0392598
39	4-36-55.38	.0804665	81	2-13-20	.0387753
40	4-30-	.0784591	82	2-11-42.45	.0383027
41	4-23-24.87	.0765492	83	2-10-7.22	.0378414
42	4-17-8.57	.0747301	84	2-8-34.28	.0373911
43	4-11-9.76	.0729952	85	2-7-3.54	.0369515
44	4-5-27.27	.0713391	86	2-5-34.88	.0365220

Sides	Angle	Sine	Sides	Angle	Sine
87	2-4-3.27	.0361023	135	1-20-	.0232689
88	2-2-43.63	.0356923	136	1-19-24.70	.0230278
89	2-1-20.89	.0352914	137	1-18-49.92	.0227292
90	2-	.0348995	138	1-18-15.65	.0227631
91	1-58-40.87	.0345160	139	1-17-41.87	.0225994
92	1-57-23.47	.0341410	140	1-17-8.57	.0224380
93	1-56-7.74	.0337741	141	1-16-35.74	.0222789
94	1-54-53.61	.0334149	142	1-16-3.38	.0221220
95	1-53-41.05	.0330633	143	1-15-31.46	.0219673
96	1-52-30	.0327190	144	1-15-	.0218148
97	1-51-20.41	.0323818	145	1-14-28.96	.0216644
98	1-50-12.24	.0320515	146	1-13-58.35	.0215160
99	1-49-5.45	.0317279	147	1-13-28.16	.0213697
100	1-48-	.0314107	148	1-12-58.37	.0212253
101	1-46-55.84	.0310998	149	1-12-28.99	.0210829
102	1-45-52.94	.0307950	150	1-12-	.0209424
103	1-44-51.26	.0304961	151	1-11-31.39	.0208037
104	1-43-50.76	.0302029	152	1-11-3.15	.0206668
105	1-42-51.42	.0299154	153	1-10-35.29	.0205318
106	1-41-53.20	.0296332	154	1-10-7.79	.0203985
107	1-40-56.07	.0293564	155	1-9-40.64	.0202669
108	1-40-	.0290847	156	1-9-13.84	.0201370
109	1-39-4.95	.0288179	157	1-8-47.38	.0200087
110	1-38-10.90	.0285560	158	1-8-21.26	.0198821
111	1-37-17.83	.0282988	159	1-7-55.47	.0197571
112	1-36-25.71	.0280462	160	1-7-30	.0196336
113	1-35-34.51	.0277981	161	1-7-4.84	.0195117
114	1-34-44.21	.0275543	162	1-6-40	.0193913
115	1-33-54.78	.0273147	163	1-6-15.46	.0192723
116	1-33-6.20	.0270793	164	1-5-51.21	.0191548
117	1-32-18.46	.0268479	165	1-5-27.27	.0190387
118	1-31-31.52	.0266204	166	1-5-3.61	.0189241
119	1-30-45.38	.0263968	167	1-4-40.23	.0188107
120	1-30-	.0261769	168	1-4-17.14	.0186988
121	1-29-15.37	.0259606	169	1-3-54.31	.0185881
122	1-28-31.47	.0257478	170	1-3-31.76	.0184788
123	1-27-48.29	.0255386	171	1-3-9.47	.0183708
124	1-27-5.80	.0253326	172	1-2-47.44	.0182640
125	1-26-24	.0251300	173	1-2-25.66	.0181584
126	1-25-42.95	.0249306	174	1-2-4.13	.0180541
127	1-25-2.36	.0247344	175	1-1-42.85	.0179509
128	1-24-22.50	.0245412	176	1-1-21.81	.0178489
129	1-23-43.25	.0243509	177	1-1-1.01	.0177481
130	1-23-4.61	.0241637	178	1-0-40.44	.0176484
131	1-22-26.56	.0239793	179	1-0-20.11	.0175498
132	1-21-49.09	.0237976	180	1-	.0174524
133	1-21-12.18	.0236188	181	-59-40.11	.0173559
134	1-20-35.82	.0234425	182	59-20.43	.0172605

Sides	Angle	Sine	Sides	Angle	Sine
183	-59-0.98	.0171663	221	48-52.13	.0142148
184	-58-41.73	.0170730	222	48-38.92	.0141508
185	-58-22.70	.0169807	223	48-25.83	.0140874
186	-58-3.87	.0168894	224	48-12.86	.0140245
187	-57-45.24	.0167991	225	-48-	.0139622
188	-57-26.30	.0167097	226	47-47.26	.0139004
189	-57-8.57	.0166214	227	47-34.63	.0138392
190	-56-50.52	.0165339	228	47-22.11	.0137785
191	-56-32.67	.0164473	229	47-9.69	.0137183
192	-56-15	.0163617	230	46-57.39	.0136587
193	-55-57.51	.0162769	231	46-45.19	.0135995
194	-55-40.20	.0161930	232	46-33.10	.0135409
195	-55-23.07	.0161100	233	46-21.11	.0134828
196	-55-6.12	.0160278	234	46-9.23	.0134252
197	-54-49.34	.0159464	235	45-57.45	.0133681
198	-54-32.72	.0158659	236	45-45.76	.0133115
199	-54-16.28	.0157862	237	45-34.18	.0132553
200	-54-	.0157073	238	45-22.69	.0131996
201	-53-43.88	.0156294	239	45-11.29	.0131444
202	-53-27.92	.0155518	240	-45-	.0130896
203	-53-12.12	.0154752	241	44-48.80	.0130353
204	-52-56.47	.0153993	242	44-37.68	.0129814
205	-52-40.97	.0153242	243	44-26.67	.0129280
206	-52-25.63	.0152498	244	44-15.74	.0128750
207	-52-10.44	.0151764	245	44-4.90	.0128225
208	-51-55.38	.0151033	246	43-54.15	.0127704
209	-51-40.48	.0150310	247	43-43.48	.0127187
210	-51-25.71	.0149595	248	43-32.90	.0126674
211	-51-11.09	.0148886	249	43-22.41	.0126165
212	-50-56.60	.0148183	250	43-12	.0125661
213	-50-42.25	.0147487	251	43-1.67	.0125160
214	-50-28.04	.0146798	252	42-51.43	.0124663
215	-50-13.96	.0146115	253	42-41.26	.0124171
216	-50-	.0145439	254	42-31.18	.0123682
217	49-46.17	.0144769	255	42-21.18	.0123197
218	49-32.48	.0144104	256	42-11.25	.0122715
219	49-18.91	.0143446	257	-42-1.40	.0122238
220	49-5.46	.0142794	258	-41-51.63	.0121764

Sides	Angle	Sine	Sides	Angle	Sine
259	41-41.93	.0121294	305	35-24.59	.0103001
260	41-32.31	.0120827	306	35-17.65	.0102665
261	41-22.76	.0120364	307	35-10.75	.0102330
262	41-13.28	.0119905	308	35-3.90	.0101998
263	41-3.88	.0119449	309	34-57.09	.0101668
264	40-54.54	.0118997	310	34-50.32	.0101340
265	40-45.28	.0118548	311	34-43.60	.0101014
266	40-36.09	.0118102	312	34-36.92	.0100690
267	40-26.96	.0117660	313	34-30.29	.0100368
268	40-17.91	.0117221	314	34-23.69	.0100049
269	40-8.93	.0116786	315	34-17.14	.0099731
270	-40-	.0116353	316	34-10.63	.0099415
271	39-51.14	.0115923	317	34-4.16	.0099102
272	39-42.35	.0115497	318	33-57.74	.0098791
273	39-33.63	.0115074	319	33-51.35	.0098482
274	39-24.96	.0114654	320	33-45	.0098174
275	39-16.36	.0114237	321	33-38.69	.0097868
276	39-7.83	.0113823	322	33-32.42	.0097564
277	38-59.35	.0113412	323	33-26.19	.0097261
278	38-50.94	.0113004	324	33-20	.0096961
279	38-42.58	.0112599	325	33-13.85	.0096663
280	38-34.28	.0112197	326	33-7.73	.0096367
281	38-26.05	.0111798	327	33-1.65	.0096072
282	38-17.87	.0111401	328	32-55.61	.0095779
283	38-9.75	.0111008	329	32-49.60	.0095488
284	38-1.69	.0110617	330	32-43.64	.0095198
285	37-53.68	.0110229	331	32-37.70	.0094911
286	37-45.73	.0109844	332	32-31.81	.0094625
287	37-37.84	.0109461	333	32-25.95	.0094341
288	37-30	.0109081	334	32-20.12	.0094059
289	37-22.21	.0108704	335	32-14.33	.0093778
290	37-14.48	.0108329	336	32-8.57	.0093499
291	37-6.80	.0107957	337	32-2.85	.0093221
292	36-59.18	.0107587	338	31-57.16	.0092945
293	36-51.60	.0107220	339	31-51.50	.0092671
294	36-44.08	.0106855	340	31-45.88	.0092398
295	36-36.61	.0106493	341	31-40.29	.0092127
296	36-29.19	.0106133	342	31-34.74	.0091858
297	36-21.82	.0105776	343	31-29.21	.0091590
298	36-14.50	.0105421	344	31-23.72	.0091324
299	36-7.22	.0105068	345	31-18.26	.0091059
300	36-	.0104718	346	31-12.83	.0090796
301	35-52.82	.0104370	347	31-7.44	.0090534
302	35-45.69	.0104024	348	31-2.07	.0090274
303	35-38.61	.0103681	349	30-56.73	.0090016
304	35-31.58	.0103340	350	30-51.43	.0089758

SIDES	ANGLE	SINE	SIDES	ANGLE	SINE
351	30-46.15	.0089502	400	27-	.0078539
352	30-40.91	.0089248	401	26-55.96	.0078343
353	30-35.69	.0088996	402	26-51.94	.0078148
354	30-30.51	.0088744	403	26-47.94	.0077954
355	30-25.35	.0088494	404	26-43.96	.0077761
356	30-20.22	.0088245	405	26-40	.0077569
357	30-15.12	.0087998	406	26-36.06	.0077378
358	30-10.05	.0087753	407	26-32.14	.0077188
359	30-5.01	.0087508	408	26-28.23	.0076999
360	30-	.0087265	409	26-24.35	.0076811
361	29-55.01	.0087023	410	26-20.49	.0076623
362	29-50.05	.0086783	411	26-16.64	.0076437
363	29-45.12	.0086544	412	26-12.82	.0076251
364	29-40.22	.0086306	413	26-9.01	.0076067
365	29-35.34	.0086070	414	26-5.22	.0075883
366	29-30.49	.0085835	415	26-1.45	.0075700
367	29-25.67	.0085601	416	25-57.70	.0075518
368	29-20.87	.0085368	417	25-53.96	.0075337
369	29-16.10	.0085137	418	25-50.24	.0075157
370	29-11.35	.0084907	419	25-46.54	.0074977
371	29-6.63	.0084678	420	25-42.86	.0074799
372	29-1.94	.0084451	421	25-39.19	.0074621
373	28-57.27	.0084224	422	25-35.54	.0074444
374	28-52.62	.0083999	423	25-31.91	.0074268
375	28-48	.0083775	424	25-28.30	.0074093
376	28-43.40	.0083552	425	25-24.70	.0073919
377	28-38.83	.0083331	426	25-21.12	.0073745
378	28-34.28	.0083110	427	25-17.56	.0073573
379	28-29.76	.0082891	428	25-14.02	.0073401
380	28-25.26	.0082673	429	25-10.49	.0073230
381	28-20.78	.0082456	430	25-6.98	.0073059
382	28-16.33	.0082240	431	25-3.48	.0072890
383	28-11.91	.0082025	432	25-	.0072721
384	28-7.50	.0081812	433	24-56.54	.0072553
385	28-3.12	.0081599	434	24-53.09	.0072386
386	27-58.76	.0081387	435	24-49.66	.0072220
387	27-54.42	.0081177	436	24-46.24	.0072054
388	27-50.10	.0080968	437	24-42.84	.0071889
389	27-45.81	.0080760	438	24-39.45	.0071725
390	27-41.54	.0080553	439	24-36.08	.0071562
391	27-37.29	.0080347	440	24-32.73	.0071399
392	27-33.06	.0080142	441	24-29.39	.0071237
393	27-28.85	.0079938	442	24-26.06	.0071076
394	27-24.67	.0079735	443	24-22.75	.0070916
395	27-20.51	.0079533	444	24-19.46	.0070756
396	27-16.36	.0079332	445	24-16.18	.0070597
397	27-12.24	.0079132	446	24-12.91	.0070439
398	27-8.14	.0078934	447	24-9.66	.0070281
399	27-4.06	.0078736	448	24-6.43	.0070124

SIDES	ANGLE	SINE	SIDES	ANGLE	SINE
449	24-3.21	.0069968	488	22-7.87	.0064377
450	24-	.0069813	489	22-5.16	.0064245
451	23-56.81	.0069658	490	22-2.45	.0064114
452	23-53.63	.0069504	491	21-59.75	.0063983
453	23-50.46	.0069351	492	21-57.07	.0063853
454	23-47.31	.0069198	493	21-54.40	.0063723
455	23-44.17	.0069046	494	21-51.74	.0063594
456	23-41.05	.0068894	495	21-49.09	.0063466
457	23-37.94	.0068744	496	21-46.45	.0063338
458	23-34.84	.0068594	497	21-43.82	.0063211
459	23-31.76	.0068444	498	21-41.20	.0063084
460	23-28.69	.0068295	499	21-38.59	.0062957
461	23-25.64	.0068147	500	21-36	.0062831
462	23-22.60	.0067999			
463	23-19.57	.0067852			
464	23-16.55	.0067706			
465	23-13.55	.0067561			
466	23-10.56	.0067416			
467	23-7.58	.0067272			
468	23-4.61	.0067128			
469	23-1.66	.0066985			
470	22-58.72	.0066842			
471	22-55.79	.0066700			
472	22-52.88	.0066559			
473	22-49.98	.0066418			
474	22-47.09	.0066278			
475	22-44.21	.0066138			
476	22-41.34	.0065999			
477	22-38.49	.0065861			
478	22-35.65	.0065723			
479	22-32.82	.0065585			
480	22-30	.0065449			
481	22-27.20	.0065313			
482	22-24.40	.0065178			
483	22-21.61	.0065043			
484	22-18.84	.0064909			
485	22-16.08	.0064775			
486	22-13.33	.0064641			
487	22-10.59	.0064509			

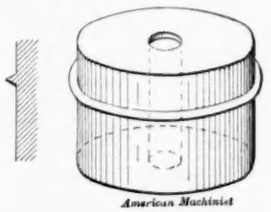
habit of polishing up the bright parts of his machine and wiping off the surplus oil in his spare moments. The addition of this item of expense for cleaning, to the weekly pay roll, at first called forth remonstrances from the general office, which, however, ceased after the first visit of the general manager to the shop; the spick and span appearance of everything in and about the premises being sufficient argument for him that the money was well spent. After things had gone on in this way for about two years the insurance inspector, after one of his periodical visits remarked, "Mr. Brown, I have noticed, with pleasure, the scrupulous cleanliness of everything about your establishment and have reported the same to our company, as a result they have decided to reduce your insurance premiums —— per cent.," which amounted to about double the yearly expenditure for the item of cleaning and sweeping; nor is this the only benefit to be derived from such a course. It is an axiom that "Like begets like," and the result of such surroundings is to make the men more careful and painstaking in their work, reducing the loss from waste and spoiled jobs, and also having the effect of drawing and holding a much better and more intelligent class of workmen than could otherwise be obtained for the same wages. I doubt whether any of Mr. Swift's gages would find any great amount of use in this establishment, as it can be readily imagined that the same antipathy which resulted in the banishment of dirt, also banished noise and smoke.

S. I. BLEY.

A Test Wheel for Alinement of Typewriters.

Editor American Machinist:

To those who are working or experimenting on rubber-wheel typewriting machines it will frequently occur that the irregularities in side and up-and-down alinement are as much due to imperfections in the wheel as in the machine, and frequently the most thorough search does not make positively clear just where the trouble is. The well-known fact that the mold will loosen up and that the matrix sections will become so displaced that irregularities in the wheel will result, gives reason to believe that in every test of a machine made with a wheel (where trouble is met with), such trouble is possibly due to irregularity in the wheel. In fact, in our shops here, it is so common to charge the wheel with all bad results, that I arrived at the conclusion that the wheel department was wrongly accused, and instead of testing the questionable machine with a regular type-wheel, I took a wheel and turned the face or periphery as shown. It will be seen that instead of characters, it has a band with a sharp edge running around the body of the wheel, and being turned on an arbor, it is presumably as true as a good lathe and careful workman can make it. Now, when the "cranky" machine was tested, it gave a crooked line *a;* when a good machine was tried, it gave a straight line. The above test was made for poor up-and-down alinement, and proved that, beyond a doubt, the machine was not what it should be. This result shows that we have been a little dull in this particular. Why, one might ask, has this not been done long ago? Here we have been disputing over the question and going into heavy expense, when it might have been solved by a test fixture over a year ago. You will observe, Mr. Editor, that here again comes into play the test fixtures and jigs. You no doubt remember your article on such fixtures; but we had no time to heed your warning, and we are proceeding in the cheapest (?) manner. But we shall now make a wheel turned on the lathe and milled by index similar to number of characters, so as to prove the side alinement also, and possibly we shall give you results of this experience, so that some other gay individual who reads the "American Machinist" may profit by our waste and his wisdom.



A TEST-WHEEL FOR ALINEMENT OF TYPEWRITERS.

JOHN G. NIEDERER.

East Rutherford, N. J.

Belts and Human Nature.

Editor American Machinist:

There is perhaps nothing more promotive of excellence of product than active

and healthy competition. No one is apt to do his best until he is driven to it. Some fellows drive themselves, but mostly we drive each other, and once in a while there is one who drives the crowd. Years ago there seemed to be a painful lack of some kind of stimulus in the belting business, and I can't say that there has been enough incentive provided even yet. There has been kicking enough about bad belts, but kicking alone does not seem to be all that is required. Variety is necessary.

A belt when bought should be ready for use, just as completely as a crowbar is; but who ever bought such a belt? It always has to go through a course of breaking-in. The breaking-in of the belt and the after experience with it in use, the time expended upon it and the time lost while waiting for it, are often much more costly than the endless strip of leather. It is not easy to find anything in connection with machinery that is dearer than cheap belting.

The new belt usually has to be stretched more or less before it settles down to business, and often this stretching in working reveals the fact that the belt never can be broken-in satisfactorily, because when it is stretched it is at the same time hopelessly crooked. I can recall some exasperating experiences with crooked belts on cone or flanged pulleys which persisted in crowding against the flanges and twisting themselves up into ropes. I have had more than one belt that I couldn't keep out of the back gears without putting up a stick to crowd it off.

The belt dealers are doing something in these days toward mitigating these experiences. They have apparatus provided in their facories for stretching the belts before they go out, so that it will not have to be done in actual service. Some makers now go further than this, or, more likely, the one thing has led to the other. The stretching of the belts is quite likely to make them more or less crooked, and so they make up the belts somewhat wider than the normal width, and after the stretching they are made straight again by the operation of trimming the edges to the finished width required.

One thing, however, you can't get the belt maker to do, and that is, to impair the looks of his belt by making it better for use. He apparently never thinks of, or at least he deliberately avoids, the getting of the belt into the best possible condition for working by making it soft and pliable and giving it the best surface for adhesion. A belt maker might provide himself with running shaft and suitable pulleys, and he might put the belts on and run them and oil them when running, and then he might advertise fully prepared belts which might be seen at work before buying. The belt has to go through all this before it is really ready for its life-work, and it would seem to be more properly the work of the maker than of the buyer. It would be easy, of course, to call a belt when thus prepared a second-hand belt; but, even so, the maker could then advertise "Second-hand belts better than new," and still find himself not in the same catagory with the Harlem grocer who had in his window a sign advertising "eggs equal to fresh."

I am afraid, after all, that the trouble about belting is not so much with the makers as with the buyers of it. The competition for excellence or for preparedness of product is neutralized by the competition for price. There are too many buyers of machine supplies who can see nothing but first cost, and as long as these prevail we must expect to see only part of the cost of the belt paid to the maker of it; the other part, if even the larger part, being paid in the disciplining of the belt in actual service.

It is wisdom begotten of experience, and of knowledge of human nature, which prevents the maker from undertaking to make his belt actually fit for instant use in full efficiency, and thus most valuable in fact, because to do so he must impair the neat and clean appearance of it. To make it much more valuable he must make it much less salable, and it is asking too much of anyone to ask him to do that.

There is still one good and sensible thing to do, and which could be done without encountering much opposition, and that is, in any establishment that uses much belting, to have a department for preparing belts for use. It is common enough to have a man assigned to the general care of the belts in a shop, and much lost time is avoided by his doing his work mostly when the belts are not running; but his function should be extended to the complete preparing of new belts for service. The expense incurred by this arrangement would be generally approved of, but the same expense if absorbed by the maker of the belts might lead to a change of purchasing agents.

I know that, comparatively if not actually, belts are not as numerous as they once were, and there may be the good time coming when the electric wires will almost entirely supersede them; but for the present it is best to get all that we can out of our belts.

TECUMSEH SWIFT.

Removing a Propeller Wheel by Gunpowder.

Editor American Machinist:

In issue No. 36 of the "American Machinist," I read a description of how a propeller wheel was removed from the shaft by freezing water in the chamber of the hub. I have had some experience in this line myself—that is, in trying to pull off wheels that refused to start. On one occasion, after trying about everything, I was about to resort to the last course, which to me was to drill a row of holes lengthwise of the hub and drive into these tapered pins and thus split the hub, when the thought struck me that a charge of gunpowder exploded in the chamber might expand the hub and thus loosen it. I accordingly had a hole drilled and put in what I was sure was not enough to burst the hub, and set it off by means of a fuse. In the mean time a good strain had been taken on the bolts I had used to pull it off with. The first charge had no marked effect, but the charges were increased gradually and the third or fourth charge opened the hub enough to let the bolts pull it off.

This may not be a very safe method, but it certainly is effective. It is, of course, understood that a safe retreat is sought during the explosion, as a spongy section of the hub might fly, although the charge was not sufficient to really burst it.

In this way it is not necessary to wait for winter to come and freeze the water, nor yet to restore to the much discussed liquid air.

NICK L. STEEL.

Repairing a Fusible Plug at Sea.

Editor American Machinist:

In reply to Mr. Robert Bryn's criticism of how I repaired the fusible plug in the Waesland, allow me to call his attention to the fact that my article was entitled, "Repairing a Fusible Plug at Sea"; not "on a locomotive" or "in a wash boiler"—but just at sea, in a plain tubular marine boiler. It would have taken tongs 6 feet long to hold the file if we had one, which is doubtful.

E. A. SUVERKROP.

Oil on Reamers and Taps Used in Cast Iron.

Editor American Machinist:

I should like to hear the opinion of some of the "American Machinist's" practical contributors on the use of oil in tapping and reaming holes in cast iron, its effect on the work produced and on the life of the tools. I believe there are supporters of both sides of the question.

A. P. BRUSH.

Detroit.

Early Rogers' Locomotives.

Editor American Machinist:

I notice on page 25 of "American Machinist," No. 36, that it is stated the first locomotive built at Rogers' shop was in 1852. Is this not an error? I have run more than one of them that came on the Delaware, Lackawanna & Western in 1851.

COLVIN.

At the shops of the Baltimore & Ohio Railway, at Connellsville, Pa, recently about 100 feet square of the ground upon which the shops are built sank about 8 feet. The subsidence was gradual, and the ground remained practically level during the operation and at its conclusion. The building, machinery, two locomotives undergoing repairs, tracks, etc., settled together without injury. The shafting has been lined up, and operations resumed.

Effects of Combination Upon Wages and Labor.

During the past two or three years a Commission appointed by Congress has been investigating the subject of the effect of combinations upon wages. Among the interests investigated was that of the American Steel Hoop Company, a combination of fourteen plants. Taking the gross figures covering the same, we find that in November, 1898, as separate plants, they employed a total of 4,545 employees, at an average wage of $1.93 per day. Take the same plants in November, 1899, after the date of their combination, and we find a total number of employees of 5,873, and the average daily wage of $2.27, or a wage gain of 17.62 per cent.

The foregoing figures cover 217 branches of occupation, from the ash-heavers and errand boys to the master mechanics—in fact, the entire operative force of the fourteen plants. The figures show that of these 217 different occupations only 12 show a decrease, as follows: Boiler repairs, 2 employed in 1898 at $2.10, in 1899 at wages ranging from $1.92 to $2.38—a net decrease of 1.19 per cent.; helpers to the foregoing, a reduction of 19.59 per cent.; clerks, a reduction in number from 73 to 53, and from an average daily wage of $2.30½ to $2.23½, or of 3.04 per cent. The number of yard foremen has been increased from 1 to 2; the wages decreased, so that where the one received $3.10½ the two receive, respectively, $1.70 and $3.83½, a decrease of 10.95 per cent. Janitors, 25.20 per cent.; machinists' apprentices, 4.85 per cent.; melters' helpers, number increased from 1 to 2, wages decreased 5 per cent.; ore crushers, number increased from 2 to 5, with 17.62 per cent. wage reduction (the scale running from $2 to $2.54 in 1898, and in 1899 from $1.45 to $2.82); roll turners' apprentices, number increased from 11 to 14, wages reduced 3.82 per cent.; shippers, 5.27 per cent.; storekeepers, 6.41 per cent.; storeroom hands, 6.25 per cent.

On the other hand, the increases of wages range from 132 per cent. to 2.60 per cent.; some of the more important increases being as follows: Dippers, 2.60 per cent.; errand boys, 77.11 per cent.; gas foremen, 40 per cent.; pit foremen, 62.86 per cent.; janitresses, 132 per cent.; lever men, 38.92 per cent.; puddlers' helpers, 25.75 per cent.; boss rollers, 80.26 per cent.; boss shearmen, from $5.50 to $8, or 45.45 per cent.; men employed stocking and grinding ore, 54.29 per cent.

The foregoing figures show an increase in the total number of employees of 1,272; the only instances in which there was any decrease being 14, as follows: Boiler repairers, 7 to 4; clerks, 73 to 53; coke drawers, 35 to 31; cut-offs, 3 to 2; coal mine drivers, 20 to 14; locomotive firemen, 6 to 5; flaring machine hands, 20 to 14; gatemen, 11 to 10; hand-in hands, 7 to 4; layovers, from 13 to 12; machinists' apprentices, 13 to 10; markers, 3 to 2; boss rollers, 16 to 9; rollers' helpers, 8 to 6.

It is also often claimed that combinations close up plants; while this is in a measure true, it must be remembered that this is often done without any lessening of labor, because plants occupying separate buildings are often combined in one larger building, and oftentimes the working capacity is increased thereby; in other instances plants that were practically worn-out before they entered the combination are immediately replaced by new ones.

A. F. TENNILLE.

[It is unsafe to draw general conclusions from isolated cases of this kind. What has been done by the American Steel Hoop Company may be the same or similar to what has been done by other combinations and may not. The figures given purport to show what the company named has done. They cannot claim to show more than that.—Ed.]

Department Stores as a Means of Increasing Our Exports of Manufactured Goods.

Vice Consul General Simon W. Hanauer has written from Frankfort, Germany, to the State Department, as follows:

"In my replies to inquiries from manufacturers in our country as to how to gain foreign markets for their products, as also in my reports to the Department, I have impressed upon our exporters the necessity of personally studying the wants of foreign markets; of meeting the usual terms of credit, time and place of delivery, standard of weight and measure; of knowing the language of customers; of combination in foreign trade, etc.

"There is another mode which promises splendid returns for those employing it, which will also stimulate our export trade. This consists in establishing American department stores in the large European cities.

"In Germany and most other continental countries, there are large retail warehouses and stores which sell different lines of dry goods and clothing for female wear. Department stores on the order of our own, containing almost everything for human needs, are hardly known here. Consequently, one finds in an European city hundreds of retail stores, carrying small stocks and selling articles at high prices. I think department stores would find conditions more favorable here than at home, in amount of sales and return on the capital invested; but the importance of the plan consists in the immense impetus they would give to the sale of American specialties—household articles of all kinds, clothing, kitchen and ironware, small machines, tools and instruments, toys, carriages and vehicles, office and dwelling furniture, fruits and meal, etc. I am confident that such a concern established in Frankfort could within a few years sell American specialties alone to an amount of $3,000,000 to $4,000,000 annually, and distribute further quantities by giving agencies to leading dealers of interior towns and cities. In shoes alone, it could transact a large trade. Our manufacturers need then but offer their products to the home purchasing office, in order to do a foreign trade."

Relative Corrosion of Wrought Iron and Steel.

At the recent international engineering congress on methods of testing construction materials, an address on the corrosion of iron and steel was delivered by H. M. Howe, the honorary president. Mr. Howe, as the result of a long series of experiments, arrived at the following conclusions: First, that despite the common and widespread belief among engineers, that soft steel corrodes much more rapidly than iron, there is really very little difference between the two in this respect, except where they are exposed to the action of salt water. If the corrosion of wrought iron be taken as 100, that of steel would be 114 in salt water; in fresh water, 94; and where the exposure is simply to the atmosphere, 103. In 3-per-cent. nickel steel the corrosion is about 80 per cent. of that in wrought iron; in 26-per-cent. nickel steel, about 30 per cent. Although the latter metal has an enormous advantage over wrought iron, it cannot be called a non-corroding metal, but rather a slowly corroding one.

Mining Affairs in the Transvaal.

Regarding the progress that is being made toward a restoration of the mining industry at Johannesburg, the London "Times" correspondent recently sent in a favorable report. Those mines which have reached the producing stage will soon, he says, be able to start crushing on ore that has already been developed, as soon as a moderate number of workers come back, as it will be possible effectively to supply the crushing mills without a full complement of men. Development work on these mines will probably be delayed for some three months later than that, but this will not interfere with running them generally, as mills, mines and machinery are all in good condition. Pumping is now going on at the mines which have most water in them, and it is thought that all will be emptied in about three months. The labor which might now be employed on the producing mines is, for the time being, diverted from them and used upon the construction of the new Springs, Rand & Vereeniging Railway. Eleven thousand Kaffirs are at the present moment employed on the new railway.

His Mistake.

The "Denver Evening Post" says: Then rose the aged chieftain Neversweat, and cast both eyes on the assembled braves, and thus he spake:

"My children, I am old!
The frosts of time relentlessly have chilled
The lubricating cups which oil my joints."

The poor and benighted Lo should have been up to date and used Dixon's Pure Flake Lubricating Graphite in his lubricating cups.—"Graphite."

A Country Without Strikes—Compulsory Arbitration in New Zealand.

Well known in England as New Zealand's energetic Agent General, the Hon. W. P. Reeves is better known in this country as the man by whose agency New Zealand has become "a country without strikes." From 1891 to 1896 Mr. Reeves, while Minister of Education and of Labor, bent his energies to the passing of industrial arbitration legislation. In the following article he describes the results of the acts on trade, commerce, and society:

"The arbitration law has been in constant use in New Zealand for about four years and a half. During those years there has never been a time when there has not been a dispute pending before one or other of the Conciliation Boards or the Central Arbitration Court.

"Writing, as I do, at some distance from London, I cannot say from memory what the exact number of disputes finally adjusted has been; but, so far, they cannot be less than sixty or seventy. Most of these have been carried, on appeal from some Conciliation Board, to the Arbitration Court and settled there.

"In about two cases out of seven the Conciliation Boards have been able successfully to arrange the disputes. Even where they have not done so, it by no means follows that their labors have been useless. Very often the appeal to the Arbitration Court is merely on one or two points out of many involved, and the advice of the Conciliation Board is accepted on the others. Often, too, most of the parties to a dispute have been ready to accept a board's suggestions, but it has needed the firm hand of the Arbitration Court to bring one or two stubborn men to acquiescence.

"The process may be tedious, but it is not costly. Lawyers are not employed as counsel before either the boards or the court unless all parties to the action agree thereto, and they very seldom do agree. A firm of employers may appear by a manager or accredited representative, a trade union is usually represented by its secretary or other official. During the hearing, of course, the factories concerned remain open, and work goes on as usual.

"Employers are secured not only against a dead stop of business, but against the meaner kinds of competition of under-cutting rivals. In the organized trades all the shops of a district have to keep the same hours and pay the same wages. No man may filch trade from a neighbor by sweating his own people. The fair-minded employer now knows where he is, and is freed from many anxieties.

"For six years there has virtually been neither strike nor lockout in New Zealand. All these, except the first, have been years of remarkable and increasing prosperity. During the time of depression which came before them, wages had fallen. With improved times employers would have been faced by resolute demands from trade unions for a return to former high rates of pay, and had there been no arbitration system in working order a series of very bitter conflicts must have ensued. This has been avoided. Workmen and workwomen have gained notable advances of pay, and also improved conditions as to hours of labor and otherwise.

"But this has come about gradually, and only after careful and painstaking inquiry. Many of the demands of labor have been refused; many more have been modified. In no case has an industry been throttled or crippled. Not only can we claim that no factory has been closed for a single day in New Zealand by labor war, but we can claim that the peace thus obtained has not been bought at the dear price of hampered industry and discouraged enterprise.

"When the Arbitration act came into operation the number of hands returned as employed in the registered factories was about 26,000. It is now not far short of 50,000. A percentage of this striking increase may be due to more thorough registration. Far the larger part of it represents an actual increase of industry.

"During these years the imports and exports of the colony have grown apace. The revenue received from the customs, from the income tax, from the stamps, and the railways has risen in each case rapidly. Employment from being scarce has grown plentiful. Building has been brisk in all centers of population. The marriage rate has gone up. In a word, New Zealand shows all the signs which we connect with a highly prosperous country.

"It would be too much to claim that this is chiefly due to the working of the Arbitration act. It is perfectly fair, however, to claim that the Arbitration act and the improved conditions of labor, and of confidence which it has brought about, have had some share in leading up to this happy state of things.

"It is frequently asked, 'How could you possibly enforce an award of the Arbitration Court upon an employer or a union stubbornly determined to go to all lengths rather than obey it?' In the first place, for nearly five years the law has been in constant use without a single exhibition of this desperate resistance. That alone should be evidence of some weight that such a duel is not likely in a British community.

"It is quite true that an employer could go out of business rather than obey an award, and that the court could not prevent him from doing so. But employers are not given to ruining themselves merely because they may not like the decision of an impartial tribunal.

"It is suggested that the decision itself might be ruinous. There need be no fear of that. Experience has shown that if arbitration err at all it is almost invariably in the direction of overcaution. They may show too great a desire to 'split the difference'; they are not in the least likely to impose intolerable conditions either upon masters or men.

"An employer who has the choice between accepting a legal decision arrived at after painstaking inquiry, and being taken into court and fined, will almost always accept the decision. In a very few cases he may run the risk of being fined once, but he will not lay himself open to a second penalty. That is the New Zealand experience.

"On the other hand, it has been flatly declared that the court cannot coerce trade unions. Vivid pictures have been painted of the tragic absurdity of endeavoring to collect fines from trade unionists by distraining on the goods of poor workmen whose union is without funds, and who are themselves penniless. The answer to that is that poverty-stricken unions, composed of penniless workers are only too thankful to accept the decision of a State tribunal.

"They cannot strike against a powerful employer; much less can they hope to starve out a court of arbitration. Its decision may not altogether please them, but it is all they are likely to get. The Arbitration Court, therefore, is as potent to deal with trade unions as with employers. Wealthy unions it can fine. Penniless unions are helpless to fight it. Finally, at its back is the mighty force of public opinion, which is sick of labor wars and determined that the experiment of judicial adjustment shall have a full and fair trial."
—"The Express," London.

Compressed Air Traction in Coal Mines.

Without attracting much attention in general mechanical circles, compressed air haulage in coal mines has steadily grown in recent years. For this service it has the fundamental point of superiority over electricity that not even the suspicion of danger from fire can be attached to it. It appears to be materially cheaper than mule traction, and about the only remaining competitor with it is the wire rope, over which it has the important advantage of flexibility and capacity for switching and hauling cars on sidings.

While, in a general way, those acquainted with the subject have long been convinced of the economy of compressed-air locomotives over mules in this service, very little in the way of exact comparison has been published. Some figures given in a recent paper* read by Mr. J. H. Bow-

* Notes on the Compressed Air Haulage Plant at No. 6 Colliery, of the Susquehanna Coal Company, Glen Lyon Pennsylvania.

den before the August meeting of the American Institute of Mining Engineers, go far to supply this deficiency and should do much to accelerate the growth of this system of mine haulage.

The plant comprises a Norwalk compressor having a capacity of 296 cubic feet of free air per minute at normal speed, and working under an air pressure of 600 pounds per square inch, and two Porter compressed-air locomotives, weighing about 6 tons and having a tank capacity of 130 cubic feet of air at 550 pounds, with an auxiliary tank of 4.2 cubic feet capacity, in which the pressure is reduced to 160 pounds and from which the cylinders are supplied. The air is conveyed down the mine to five charging stations, properly distributed. The grades average 1 per cent. in favor of the load. The cars weigh 2,800 pounds empty and 9,800 pounds loaded, and are hauled in trains of from twelve to twenty cars, the average being about fifteen. One engine hauls about 355 and the other 320 cars per day of ten hours. The two engines have displaced thirty-two mules, formerly employed for the same work. The total cost of the plant was $15,156, against $4,052, the estimated value of the mules.

The comparison of cost is carefully worked out, a test of the cost of coal and oil having been made, to which the charges for labor, repairs, interest and depreciation have been added. The following is a summary of these figures:

	1897 (179 days)	1898 (160 days)
Total cost of haulage by mules.....	$11,328.63	$10,713.98
Total cost of haulage by motors.....	3,979.38	3,843.53
Sav'g due to motors.	$7,349.23	$6,870.45

The total saving for the two years is thus seen to have been $14,219.70, which is but little less than the entire cost of the plant. With continuous working, the cost of the plant would be saved in 361 working days.

One of the locomotives is worked to about one-half of its capacity, and the other to about one-third. The compressor, however, is fully loaded, and another one has been ordered. No direct comparison of the cost of haulage per year by mules and by the compressed air plant when fully occupied is made, but a comparison between the cost per ton-mile by mule and by compressed air traction under actual conditions and those expected later on, is made as follows:

	1897 Conditions.		1898 Conditions.		
	Mules.	Compressed Air.	Mules.	Compressed Air.	Enlarged Air Plant, 300 Days per Year.
Cost of traction per gross ton, cents....	2.98	1.05	2.98	1.07	.547
Cost of traction per net ton, cents.....	5.34	1.89	5.38	1.93	.984

Legal Notes.

BY WM. MARSTON SEABURY.

WAIVER OF VENDOR'S WARRANTY BY ACCEPTANCE OF MACHINERY WITH OBVIOUS DEFECTS.

C. B. Fee brought suit against G. W. Sentell in the Civil District Court, Parish of Orleans, Louisana to recover part of the purchase price of certain sugar-house machinery. The machinery consisted of a vacuum pan and adjuncts or attachments made up of condensers, coils, centrifugals, engines and other parts, for which the defendant bound himself to pay the sum of $6,150; and of other machinery consisting of one Newell National cane-shredder and parts, for which the defendant agreed to pay $2,500. Part of the total cash price was to be paid on delivery of the machinery and the remainder some months later.

The judgment of the court directed the defendant to pay to the plaintiff the sum of $1,103.44, from which judgment the defendant appealed to the Supreme Court.

The defendant contended that the machinery was defective. It appeared from the testimony of an expert that the centrifugals were working as well as could be expected for second-hand machinery; while another expert, who erected the machinery, testified for the defendant that parts of it were broken, and that the machines, especially the entrifugals, were defective and looked like "a lot from an old junk shop." The Appellate Court held that as to all the machinery except the centrifugals, the judgment of the lower court should be affirmed, for the reason that the defects were capable of ascertainment on a reasonable inspection, and that the defendant, by his acceptance and use of it, waived the vendor's warranty that it was fit for the purposes for which it was bought. As to the centrifugals, the contract set forth that they were "in perfect condition." After very little use, one of the centrifugals flew all to pieces, another broke down and a third became of very little use. The court concluded that, upon the testimony offered, it was clear that there were defects in the centrifugals which were not apparent, and that as to them the judgment of the lower court should be reversed. (28 S. R. 280.)

Examination for Structural Steel Draftsman.

The United States Civil Service Commission announces that October 23-24, 1900, an examination will be held in any city in the United States where it has a local Board of Examiners, for the position of structural steel draftsman. The examination will consist of the following subjects: Mathematics (applied to structural steel work), materials and construction, designing and detailing, specifications, education and experience. From the eligibles resulting from this examination it is expected that certifications will be made to the position of structural steel draftsman, Department of Yards and Docks, Mare Island, Cal., at a salary of $4.80 per diem, and to a similar position in the League Island, Pa., Navy Yard, at a salary of $4 per diem, and for similar vacancies as they shall occur. Preference may be given to eligibles who are residents of the place or vicinity where the vacancy exists. Persons who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application forms 304 and 375, which should be properly executed and promptly forwarded to the Commission. An examination will be held the same days for assistant in the Nautical Almanac Office.

Two Honest, Unbiased and Infallible Trade Journals.

For some time past our friends have been occasionally referring to us, for an opinion or to afford us some innocent and inexpensive amusement, specimens of literature sent out by the "Southern Review of Commerce," of Louisville, Ky., and a little while ago we received a letter from

Machinery, Machines and Parts Thereof of Domestic Manufacture.	July— 1899 Quantities.	July— 1899 Values.	July— 1900 Quantities.	July— 1900 Values.	Seven Months Ending July— 1898 Quantities.	Seven Months Ending July— 1898 Values.	Seven Months Ending July— 1899 Quantities.	Seven Months Ending July— 1899 Values.	Seven Months Ending July— 1900 Quantities.	Seven Months Ending July— 1900 Values.
		Dollars.		Dollars.		Dollars.		Dollars.		Dollars.
Cash Registers	....	58,851	545	40,441	....	(a)	....	58,851	....	435,511
Electrical	....	250,462	....	497,542	....	1,296,592	....	1,598,039	....	3,040,273
Laundry Machines	....	31,808	....	47,463	....	(a)	....	31,808	....	306,193
Metal-working	....	532,485	....	558,639	....	2,978,895	....	3,860,116	....	4,238,736
Printing Presses, and parts of	....	60,137	....	80,730	....	489,978	....	518,949	....	721,672
Pumps and Pumping Machinery.	....	247,296	....	206,173	....	1,233,756	....	1,724,839	....	1,779,596
Sewing Machines, and parts of	....	317,347	....	364,861	....	1,945,969	....	2,193,883	....	2,679,343
Shoe Machinery	....	108,032	....	79,620	....	535,333	....	512,833	....	685,950
Steam Engines, and parts of—										
Fire	....	....	1	600	6	6,328	3	13,713	4	7,380
Locomotive	16	122,068	32	385,618	365	3,195,595	256	2,224,360	313	3,312,463
Stationary	81	48,829	174	101,038	319	238,087	440	243,487	798	473,954
Boilers and parts of Engines	....	157,355	....	181,526	....	625,491	....	663,618	....	1,016,282
Typewriting Machines, & parts of.	....	204,570	....	208,743	....	1,242,429	....	1,678,937	....	1,604,291
All other Machinery, and parts of.	....	1,473,611	....	2,035,358	....	8,449,345	....	11,096,491	....	13,850,249

(a) Included in "All other Machinery" prior to July, 1899.

OFFICIAL STATISTICS OF MACHINERY EXPORTS, INCLUDING JULY, 1900.

Loring Coes & Co., of Worcester, Mass., from which we abstract as follows:

"We hand you inclosed the sixth wad of editorial copies, so called, which we have received from our friends in Louisville. This is the greatest collection of 'rot' that we ever have received, and as we have proof that there are many people in New England who have been more or less victimized by this concern, we hand it to you for your comment, and you may make whatever use of it you desire. If we remember rightly, the Barrel & Box Publishing Company, in Louisville, took this matter up some time since, and we were much surprised to get this letter after their arraignment of the concern, who called themselves The Southern Review of Commerce. Probably there are many people who would like to see themselves in print and who would be victimized by this form of so-called advertising, but with whom a legitimate advertising agent would have no possible chance. Such people perhaps ought to be victimized once or twice, but when we see this continuous sending of gold bricks to the unsuspecting public without hindrance, it seems as though a little publicity would help the matter greatly."

The "rot" referred to is typewritten copy, marked with a blue pencil "Editorial copy. Please return as soon as possible," and is as follows. We copy literally:

HARDENING AND TEMPERING.

"The Southern Review Of Commerce is in receipt of several letters from interested Southern subscribers, asking us to recommend some reliable concern making a specialty of hardening and tempering for punch, press and drop work. In order that we might be able to make a recommendation that could be relied upon by all, we decided to make a thorough investigation of the various concerns engaged in this line of business and answer editorially. In this investigation along the entire line of all the leading concerns, we have given strict attention to every detail which we believe is necessary, and as a result, we are forced to concede the preference to Loring Coes & Company of Cleveland, O. [*sic*]. This company is one of the oldest and most reliable concerns of this kind in the country and the quality of their work is beyond criticism. They have been actively engaged in this line of business since the year of eighteen hundred and thirty. Their plant is equipped with all the latest and most improved machinery and appliances for good and rapid work, and having the best of shipping facilities are in a position to fill all their contracts with promptness and dispatch. The extreme care they take with all their orders whether large or small, the skilled mechanics they employ, the painstaking supervision they make of all their work before placing it with the trade, and the materials used, is conclusive evidence that we have made no mistake in recommending them to our readers as being the acknowledged leaders in this line of business. We take pleasure in recommending this company to our readers, and advise them to write them for any further details and information that may be desired. This editorial is published for the sole benefit of our readers who have requested the information, that they may know where the best work in this line can be secured. In conclusion we wish to state that we disclaim any desire to advertise the above named company, as our unqualified indorsement is based on a thorough investigation, and is wholly gratuitous on our part, honest, unbiased and uninfluenced."

This was accompanied by the following letter:

"Louisville, Ky., Aug. 8, 1900.

"Loring Coes & Co., Worcester, Mass.:

"Gentlemen—The enclosed is an editorial prepared on the subject of hardening and tempering. And as we have mentioned your company therein, we wish you to see it before publication. And as we desire it to be as correct as possible, kindly add to or alter it as you may think best, and return as soon as possible. This will be published editorially, and in consequence without charge to you. If you would like to have any copies of the issue in which it will appear, please advise us when you return the copy how many to reserve for your use. We have a list of names of those whom we know to be interested in your line, and if you so desire we will mail the copies to them and forward you the list. We make no charge for postage, marking, wrapping and addressing.

"The price of the Review is 15 cents per copy, but we can supply you with 100 copies at 12 cents, 250 at 10 cents, 500 at 9 cents, or 1,000 or more at 8 cents per copy. An order for 100 copies or more will also entitle you to a year's subscription without further charge to you. In any case, whether you wish to use the copies or not, please return the copy enclosed, corrected or O. K.'d.

"Yours very truly,

"SOUTHERN REVIEW OF COMMERCE.
"R. FRANKLIN STARR, Editor."

In answer to our inquiry as to what became of the five "wads" of similar stuff previously received by Loring Coes & Co., that firm writes us:

"We sent the first bundle back to the 'Southern Review of Commerce,' the second we put into the waste basket, the third and fourth we kept for curios, and the fifth we handed to Mr. Defebaugh as proof of our assertion that Kentucky was a bad place. That was after the appearance of his article in 'Barrel and Box,' referring to the matter in a promiscuous way. He did not specify the methods or firms to which these circulars have been sent."

One cannot help wondering why some of these previous "wads" were not published by the "Southern Review of Commerce," and what their many readers who want to know the best concern in this line of work, and who depend entirely upon the expert, thorough, "honest, unbias d and uninfluenced" investigation of the editors of the "Southern Review of Commerce" to steer them in the right direction before placing orders, are doing while awaiting the publication of this authoritative announcement. There are perhaps other sources of information for them, however; because later we received another letter from Loring Coes & Co., accompanied by a very similar "wad" of "rot" from the "Southern Trades Record, of Cincinnati." Their proposed editorial is entitled "Necessity of Using Modern Machinery," and is written with a pencil, in true editorial style. This is far worse than the editorial quoted above, but is too long to be printed here. It is evidently machine-made, however, and with the change of a word here and there will fit any manufactured thing under the heavens, from an automatic gear cutter to a jackknife. In fact, although Loring Coes & Co. make no machinery, the editorial says: "The great object of increasing output and reducing labor cost is aimed at and attained in their *machinery*. Highest efficiency, greatest convenience and ease of manipulation, fast and perfect work, solid, substantial construction, durability—these are the points which have made the *knives* made by Loring Coes & Co. famous throughout the world." This is made, we perceive, to fit anything; but by an oversight the word machinery was not changed to fit the particular case in hand. The letter accompanying this last editorial is similar in style to the one we print above, and makes substantially the same proposition.

Inquiry for Machinery.

(134) Names and addresses of manufacturers of machines for automatically making paper boxes and packing in the same soft, dry materials such as cotton.

Foreign Postage Rates.

An Englishman recently traveling in America sent home three closed envelopes on which excess postage of 90, 80 and 40 cents had been collected. It should be known that letter postage from or to England requires 5 cents for every ½ ounce. Printed matter or manuscript may be sent in England for 1 cent (½d.) per 2 ounces. Ordinary letter postage in England is 2 cents for 1 ounce and 3 cents for 2 ounces, after which each additional 2 ounces go for 1 cent. To the United States, however, manuscript will not go for newspaper rates of 1 cent for 2 ounces, but must have a minimum of 5 cents, which, however, will carry up to 10 ounces, and it should be marked "Commercial papers." As mail matter is sent both ways very deficient in postage, the excess, being charged

double, often amounts to a good deal. Our own experience also goes to show that Americans are not the only sinners in this matter.

New Catalogs.

The Watson-Stillman Company, 204-210 East Forty-third street, N. Y., sends Catalog No. 60, comprising an assortment of jewelers' and diemakers' hydraulic tools, compiled from its illustrated sheets of machinery. In the pamphlet are shown die presses, hydraulic pumps, packings, etc. Size, standard, 6x9 inches.

A catalog of emery grinding machinery, polishing machinery and supplies has been received from L. Best, 45 Vesey street, New York, selling agent for the Sterling and Safety wire web emery and corundum wheels. A feature of the pamphlet is the extensive line of plain grinding machines which it represents. It is of standard size, 6x9 inches.

The Newton Machine Tool Works, Vine and Twenty-fourth streets, Philadelphia, have published a substantial catalog, No. 34, showing a great variety of machine tools, including milling, slabbing, rotary planing, boring, drilling, slotting, cutting-off and gear-cutting machines and others. It contains 192 pages and is bound in cloth. Size of page, standard, 6x9 inches.

W. F. & John Barnes Company, Rockford, Ill., sends us No. 55, a price list and descriptive catalog of its metal-working machinery. The chief place is given to the company's line of upright drills, among which are a friction disk and a three-spindle drill. A water emery grinder and an adjustable screw press are shown, and of course the company's line of foot-power lathes, besides lathe tools and attachments. Size, standard, 6x9 inches.

The Seneca Falls Manufacturing Company, Seneca Falls, N. Y., sends a catalog, No. 17B, of foot and power lathes, accessories and specialties. The company is maker of the "Star" screw-cutting engine lathe. Among the accessories and specialties are several patterns of chucks, the "Star" tapping attachment and the "Star" ball-bearing arbor press. The size of the pamphlet is standard, 6x9 inches. The company has also published Catalog 16A, of foot and hand-power wood-working machinery.

We have received from J. W. Cregar, machinery sales agency, Philadelphia, Pa., a pamphlet relating to the product of the American Turret Lathe Company, Wilmington, Del., entitled "Three Points of View." These points of view are those of the proprietor, the superintendent and the operator. The illustrations show a 24-inch semi-automatic turret lathe and a 40-inch semi-automatic turret lathe, an unusually large and powerful machine of the kind. Standard size, 9x6 inches.

The Industrial Water Company, of 15 Wall street, New York, has published an instructive pamphlet of forty-two 4x6-inch pages, which gives a reprint of Mr. C. H. Koyl's articles on "The Work of Railroad Men on the Problem of Pure Water for Steam Boilers," which first appeared in the "Railroad Gazette." The pamphlet gives an account of the labors of a committee of the Railway Master Mechanics' Association, first formed some thirty years ago, and concludes with a very optimistic statement of the results which are now possible through the chemical treatment of boiler waters.

From the American Brake Company, St. Louis, Mo., manufacturer of locomotive driver and truck brakes for every class of service, have been received copies of a book containing a series of forty large plates, most of

(*Continued on page* 45.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 20.

Dies & punches. Amer. Hdw. Co., Ottawa, Ill.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Manufacturer wanted for medium weight machinery. Address "Established Line," Box 292, AMERICAN MACHINIST.

Will trade for a good farm or sell machine shop with a good business in N. E. Iowa. Address Box 258, AMERICAN MACHINIST.

Boilers and Engine for Sale—Two Fox boilers, 80 and 60 H.-P., A1 condition, and one 20 H.-P. engine. Box 24, Weehawken, N. J.

Machine shop for sale in the eastern part of Wisconsin, doing a general repair and jobbing business, also selling engines, boilers, machinery, etc. Box 306, AMER. MACHINIST.

Treasurer's position with established manufacturing business, by an expert accountant and capable manager ; would invest $5,000 to $10,000 ; highest references. Address Box 334, AMERICAN MACHINIST.

$6,000 in up-to-date tools idle ; who's got the specialties to keep them busy? Screw and milling machines, surface grinder, press, gear cutter, gas furnace, gages, etc. ; Western location ; large city. Box 322, AMER. MACH.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wanted—To purchase, within the next two or three weeks, a second-hand portable air riveter, capable of driving a ¾-inch rivet ; a fairly light riveter which could be operated from a yard crane would be most suitable. Address communications to Post Office Box 513, Troy, N. Y.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Assistant superintendent of shop employing 200 machinists, desires a change. Address Box 312, AMERICAN MACHINIST.

First-class drop forging die-sinker, toolmaker and designer wants position. Address Box 328, AMERICAN MACHINIST.

Wanted—Position by mechanical engineer, to assist in designing, drafting and erecting power plants. Box 323, AMER. MACHINIST.

Marine and stationary engine designer and draftsman, age 34, with extensive experience, wants position. Address Box 326, A. MACH.

Toolmaker—An Eastern man, on punches, dies, automatic machinery ; can take charge ; 15 years' experience. Address R. W. B., care AMERICAN MACHINIST.

Situation wanted by two machinery molders (iron or steel) ; 9 and 10 years' experience ; ages 24 and 25 ; best of references. Box 327, AMERICAN MACHINIST.

Skilled designer of special and standard machine tools and jigs, for 5 years chief draftsman ; technical education ; American. Box 330, AMERICAN MACHINIST.

Position as superintendent in plant manufacturing light interchangeable metal work ; 20 years' experience brass work, sewing machines and bicycles. Box 287, AMER. MACH.

Foundry foreman wishes change ; 26 years' experience in all kinds of marine and stationary engine work ; good references as to sobriety, ability and character. Box 329, AMERICAN MACHINIST.

Master mechanic desires a change ; would prefer a position with steamship company or manufacturing concern ; 7 years with present employers on machinery installation and general repair work. Box 320, AMER. MACH.

An experienced engineer, college graduate, 33 years old, desires a selling agency or position as local agent in New York city for a manufacturing concern of high standing ; compensation in commissions or salary ; highest references. Box 321, AMER. MACHINIST.

Position in machinery sales department wanted by technical graduate ; 9 years' business experience ; thoroughly familiar with all details of office work and management ; at present employed in similar capacity with large manufacturing company. Address Box 315, AMERICAN MACHINIST.

Technical man, all-around practical machinist, experienced in designing and building automatic machinery and dies, handling help and purchasing supplies, etc., at present mechanical superintendent in factory employing 250 hands, desires to sever his connection with concern now with. "Combination Dies," AMERICAN MACHINIST.

Mechanical engineer of wide experience, intimately acquainted with everything pertaining to shop practice, will shortly be open to engagement as mechanical superintendent or similar position ; 40 years old ; successful record as mechanic, foreman, chief draftsman and superintendent ; capable of producing results. Box 328, AMERICAN MACHINIST.

Foundryman, who has broad experience in light and medium castings and who is thoroughly acquainted with machine molding, wishes to communicate with a firm which can use such a man ; applicant is not out of position and has good ideas for molding and core-making machinery and for cores and mixtures ; he is also a good wood and metal pattern maker, and has experience in machine shops. Address Box 319, AM. MACH.

General superintendent and machine works manager ; 30 years' practical experience ; expert draftsman ; highest references from past and present employers ; experienced in printing presses, webs, stop cylinders, two-revolution, jobbers and lithograph ; hydraulic machinery, steam and power plants, machine tools also in specialties ; correspondence solicited with parties requiring a first-class man either as superintendent, manager or manager of sales department. Address Box 286, AMERICAN MACHINIST.

Help Wanted.

Wanted—Young man as mechanical draftsman, with technical education preferred. Address H. D. Johnson, South Bend, Ind.

Wanted—An experienced foreman to take charge of drop forge plant. Address Box 335, AMERICAN MACHINIST, giving experience.

Draftsmen desiring extra money, state where employed, confidential. Edwin Guthrie, Corcoran Building, Washington, D. C.

Wanted—Draftsman with experience in machine tool designing ; state experience and where employed. Address Box 331, AM. M.

Wanted—Good foundryman, also patternmaker ; New Hampshire. Address, stating experience and wages expected, Box 333, AM. M.

Wanted—Machinist and draftsman ; one familiar with paper-mill machinery preferred ; state experience and salary. W. M., care AMERICAN MACHINIST.

Wanted—Machinist to take charge of shop in Rochester, N. Y., employing 25 hands and growing fast ; must be up to date ; give experience, reference, age, etc. A. L. G., AM. M.

Wanted—Experienced toolmakers for armature and pole dies, jigs, fixtures, etc., in a large electric manufacturing works near New York city ; state experience. Box 288, AMERICAN MACHINIST.

Wanted—Two first-class screw machine hands to work on Brown & Sharpe hand machines, also two experienced monitor lathe hands ; give age and experience. Address Box, 332, AMERICAN MACHINIST.

We are enlarging our works, and will shortly require an increased number of skilled mechanics ; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company East Pittsburgh, Pa.

Wanted—A foreman of gear-cutting department ; must have had experience in turning out work accurately and cheaply, and must be well informed regarding the manufacture of all kinds of gears, especially bevels. Address T. F., No. 1301 Park Bldg., Pittsburgh.